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**ONE DOLLAR**

# Power

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TECHNOLOGY DEPARTMENT

*the magazine of energy systems engineering*

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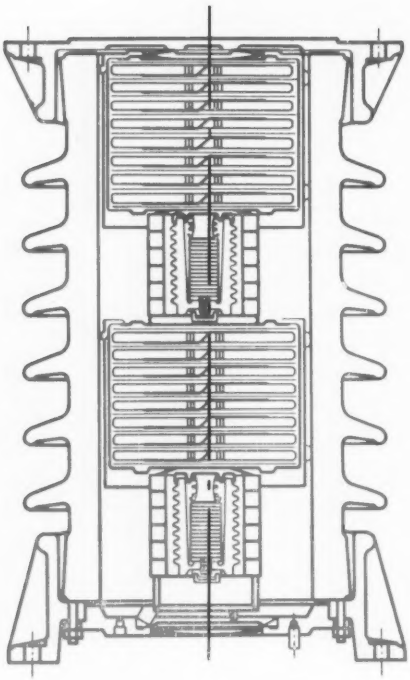

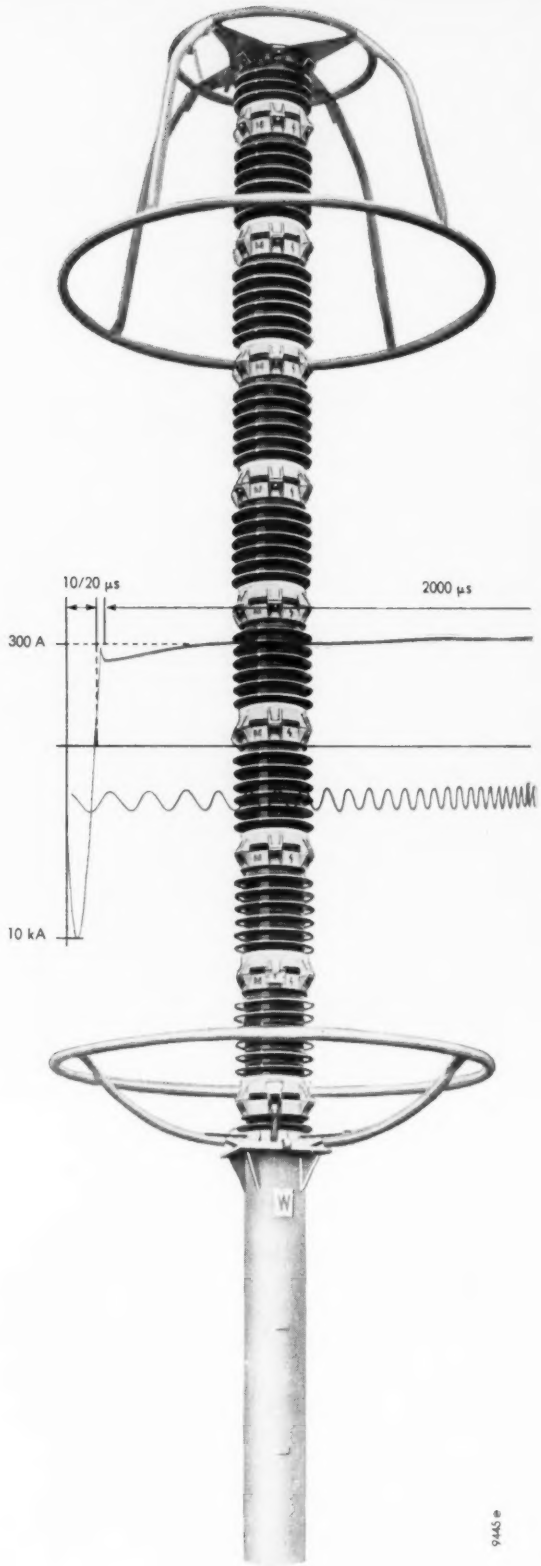


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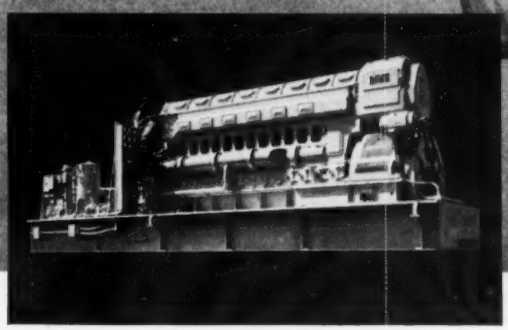

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## *speaking of* **Power**

**City of Sudbury** is located in the heart of a mining area in the Province of Ontario. Members of the Canadian Institute of Power Engineers working in that region recently gathered in the Hotel Frontenac to hear POWER's Managing Editor, Jim O'Connor, speak of the many changes in electrical engineering now taking place, and how those changes will affect energy systems engineers. Just the night before, Jim addressed a similar group of engineers in London, Ontario.

From Sudbury, Jim took a TCA flight to North Bay, rented a car and drove to the nuclear installations in Chalk River and Rolphton. Then on to Ottawa, a flight to Toronto, an evening talk before IPE members. This kind of talking-tour is an occasional part of a POWER editor's busy life.

***Power* editors** spend 10 to 20% of their time tracking down article leads, attending engineering-society meetings, visiting readers in their offices. Editors are active in engineering societies; they serve as directors, committee chairmen, present technical papers.

Keep in mind, however, that developing ideas for articles, TD's and special reports is basic to the job. An editor doesn't sit back, holding his blue pencil, waiting for articles to drop over the transom. More often he is first to break technical ground by spotting better methods, reporting them directly or locating the best-qualified engineer to tell the story.

**Sound interesting**—as a life's work? It could be yours. A young engineer, yet unselected, will shortly join POWER's editorial ranks. This new Assistant Editor might have been schooled in mechanical or electrical engineering before spending several years in design or management of energy systems.

If this appeals to you, not merely as a job but as a way of life; if you have the necessary engineering ability plus journalistic leanings; write me now, including all pertinent facts.

Lou Rowley


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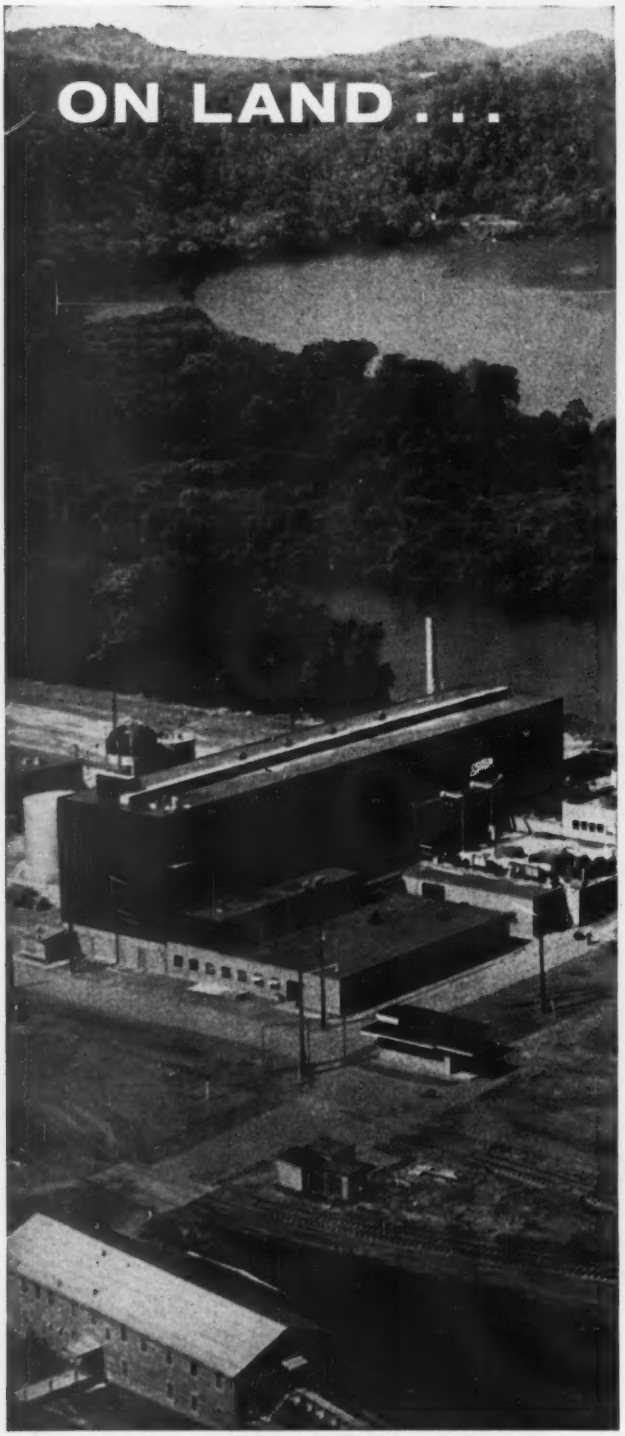


At the Shippingport Station, world's first full-scale atomic, electric power plant devoted exclusively to civilian use, Bailey instruments and controls help to secure full capacity and safety.

Typical of the modern U.S.-Flag tanker fleet using Bailey controls is the ESSO Gettysburg. You'll also find Bailey controls aboard Naval ships, cargo ships and lake steamers.

Bailey meters and controls in centralized control room at Tulsa Power Station, Public Service Company of Oklahoma. In steam-electric generating plants of this kind, Bailey has installed more combustion, feed water and steam temperature controls than have all other makers combined.

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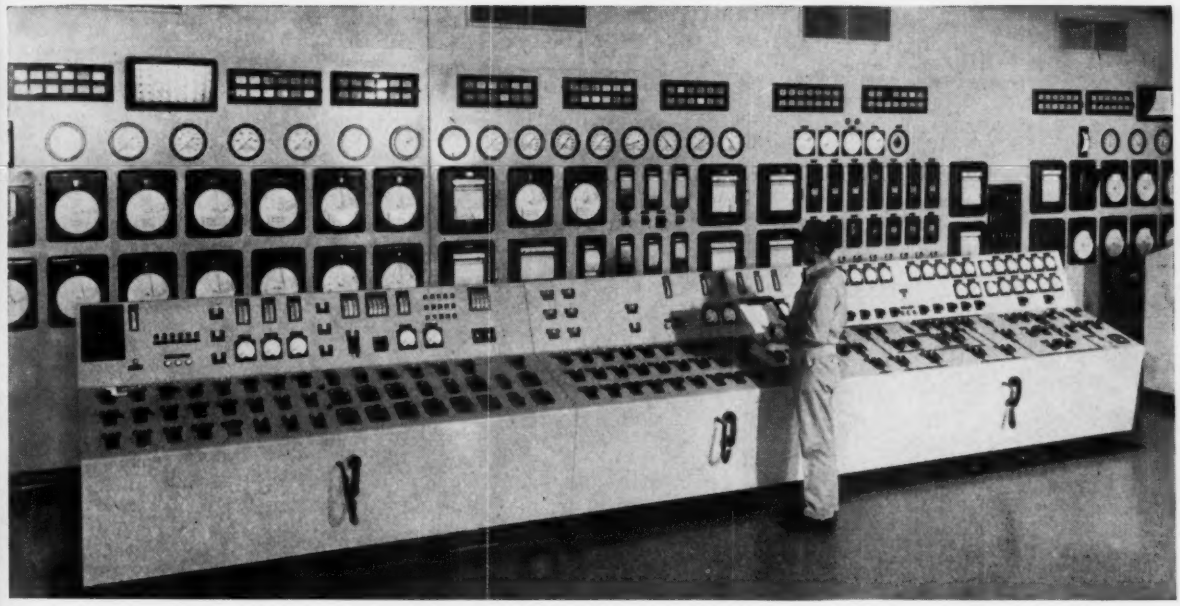

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Many of the power plants of the future will have controls and instruments designed and built by Bailey. There are two reasons: Bailey's continuing research and development toward the latest equipment for industry's needs; Bailey's 40-year association with the hardware and economic requirements of the industry.

If you are planning new or improved power plant facilities, call on Bailey engineers to insure that your system will have the *proper balance both as to economics and needs . . . that there will not be the unnecessary expense of over-instrumentation or control . . . nor the duplication of equipment functions.*

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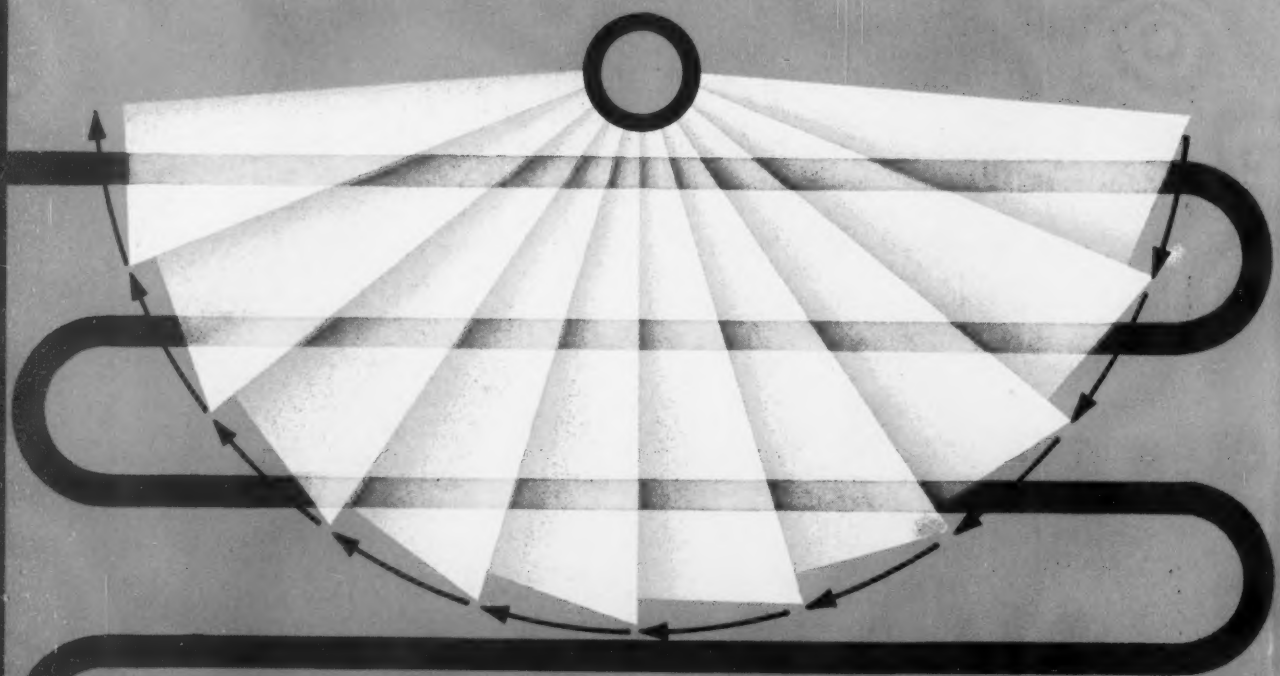
Diamond developed for more economical power...

# AIR PUFF BLOWING=CLEANER BOILERS... AN APPRECIATIVE PUBLIC

## THIS.....



Shaded area indicates sustained effective cleaning pattern.

Two of today's more critical conditions for efficient steam generation . . . clean boilers and acceptable stack emission . . . are assured with Diamond Air-Puff Soot Blowing Systems.

**Increased cleaning efficiency** is obtained because high density air is used as the cleaning medium and emitted in sustained high pressure puffs that are independent of receiver capacity or compressor size. Also, because no air is emitted at ineffective low pressures, there's greater economy in *use* of cleaning medium.

**Acceptable stack emission** is achieved because intermittent air puff blowing eliminates more concentrated and objectionable emission caused by continuous blowing arcs or blowing puffs of longer duration. In the standard Diamond Air-Puff System, intervals between air puffs are determined by the time required for build-up to optimum blowing pressure; however, if more positive control of stack emission is desired, intervals can be regulated by a simple valve adjustment.

The Diamond Air-Puff Blowing System for new *or* existing boilers of any type and capacity is further evidence of why "Diamond developed" means more economical power. Our engineers will be happy to discuss its application to your units. Call, write or wire for complete information . . . and thank you for reading our advertisement.

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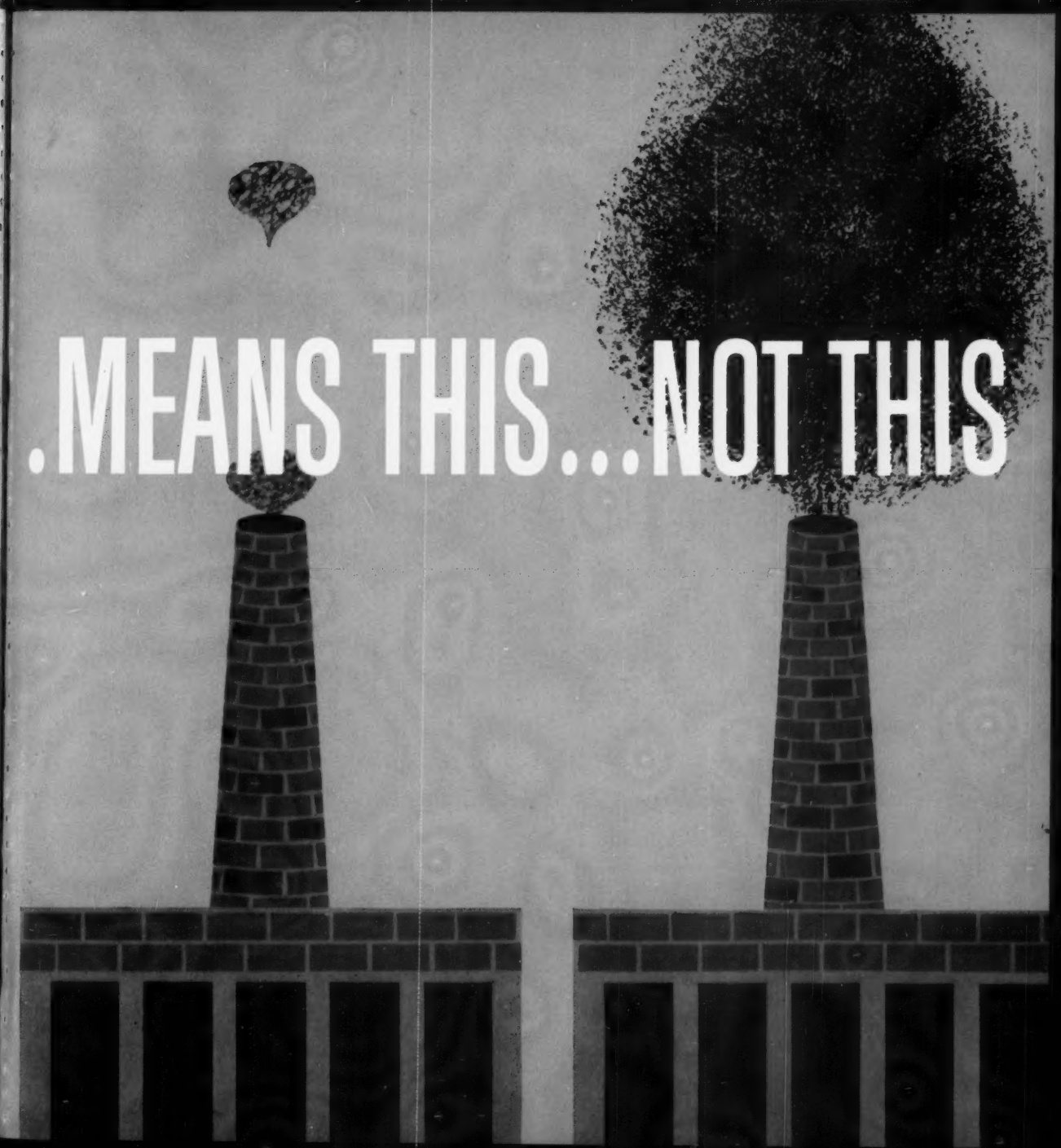
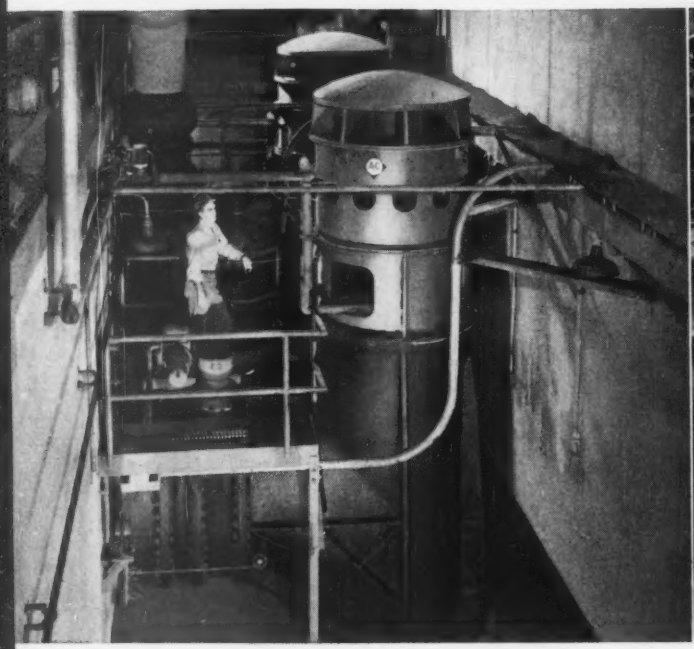
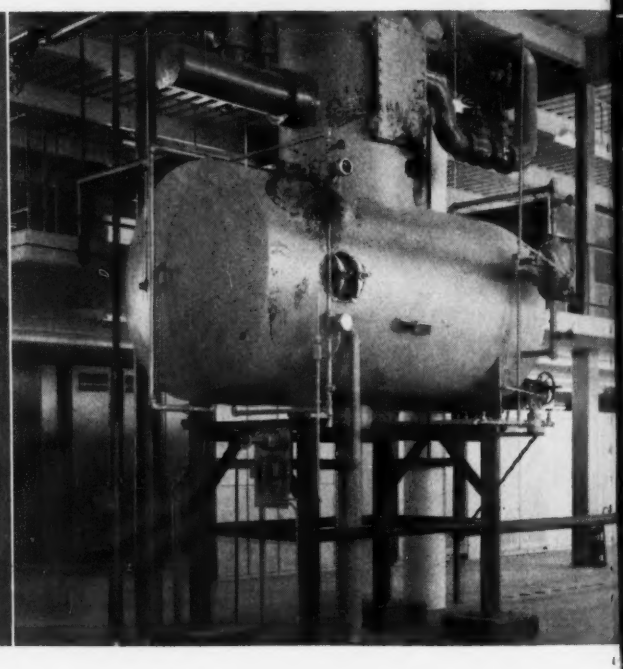


Current news reports

# WHAT'S HAPPENING IN POWER SERVICES?

**Highlights:** Switchgear with the lowest silhouette on the market. A "guided flow" condenser that slashes space requirements. These examples demonstrate the extra value that is standard with Allis-Chalmers . . . the greater efficiency and the added productivity that are yours when you buy A-C products, systems and services. Call your nearby Allis-Chalmers office for details or write Allis-Chalmers, Industries Group, Milwaukee 1, Wisconsin.

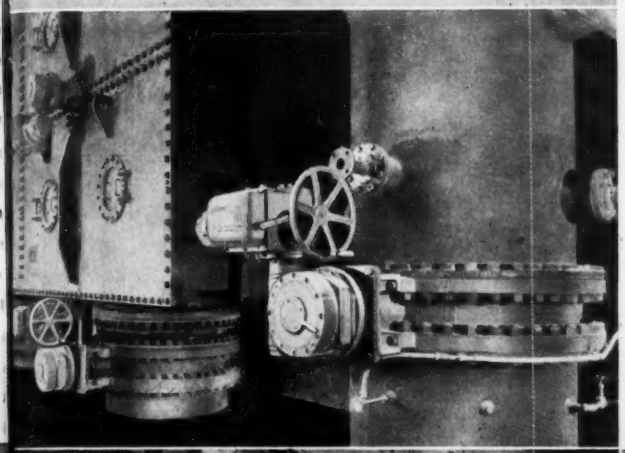




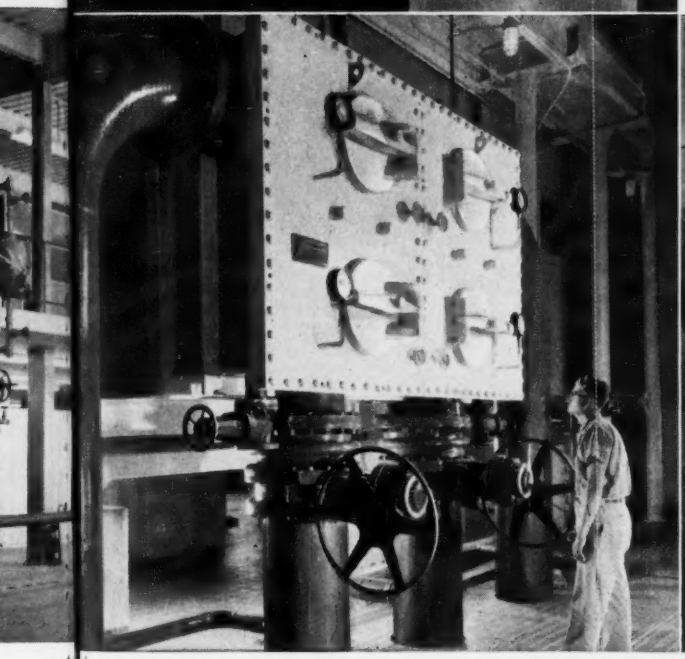
**Rugged construction for continuous operation** at highest possible efficiencies — yours with these condenser circulating water pumps and vertical induction motors. All pumps are tested at rated head and capacity to assure guaranteed performance. Available in a wide variety of materials to meet your installation needs. *Super-Seal* motors, with *Silco-Flex* insulation, assure complete reliability for outdoor installations and areas with high humidity or contaminated atmospheres.

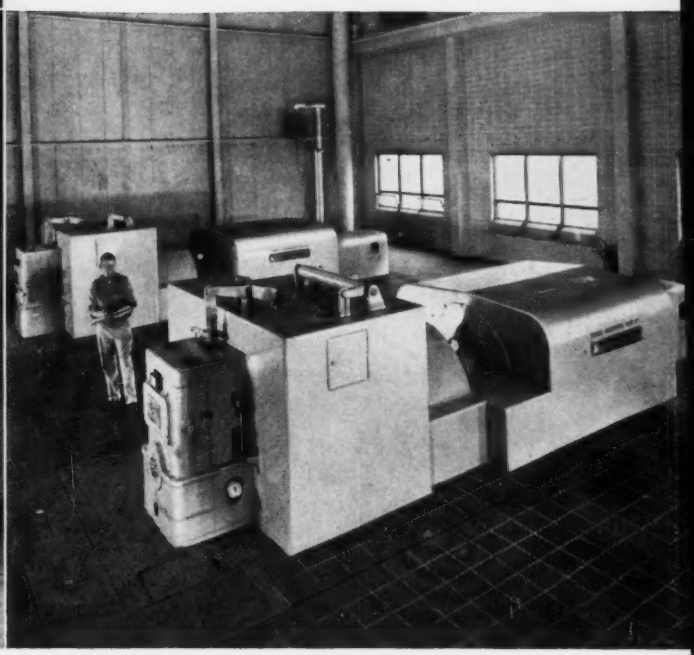
**Stainless steel "scorns" corrosion** — It's standard with all Allis-Chalmers tray-type deaerator internals. This 90,000 lbs. per hour "package" unit removes oxygen and other corrosive gases besides heating boiler feedwater. Heating and distributing tray design provides greater spillage edge — extra-efficient air separating trays remove more oxygen and gases through full counterflow design. Protects boiler and associated steam and condensate equipment from corrosive attack.

**Lowest height, easiest access** 5-kv metal-clad switchgear on the market. Just 72 inches high, you get eye-level instrumentation, shoulder-height accessibility of component parts. Other outstanding advantages: front-accessible current transformers; maximum compartmentation and dead-front construction for greater safety; full-panel metering; rapid, one-stroke breaker insertion. Choice of stored energy or solenoid operated circuit breakers.



**Eliminate tuberculation and oxidation,** reduce maintenance with rubber-seated butterfly valves. Operation is always extra-smooth and easy with 100% effective shutoff. Full body protection is offered by a rubber seat that extends through the valve body and over the flange faces. Angle seating protects the rubber seat and permits seating adjustment without costly disassembly. Being light and compact, these valves require less space and support than most other types.





**Extra-compact rectangular steam condenser shape** reduces space requirements. "Guided-flow" design achieves highest efficiency and vacuum with available water temperatures . . . gets maximum temperature condensate at the hotwell. Internal reverse-flow design for cooling water effectively backwashes debris, ends costly shutdown, conserves space, requires no additional piping. Planned-as-a-package auxiliary condenser equipment also available.

**Two non-condensing, automatic extraction steam turbine-generator** units (3000 kw) — for a hospital center where extraction and exhaust steam are used for heating and other services. You get the advantages of two steam pressures — high pressure by automatic extraction and low pressure from the exhaust. Use of pressure-reducing valves and desuperheaters is minimized where a wide range of process pressures is desired.

*Super-Seal and Silco-Flex are Allis-Chalmers trademarks.*

**ALLIS-CHALMERS**

A-1479

# Oval "overcoat" for a problem pipeline

## J-M METAL-ON
## *in "long-legged" form cut insulation costs for Shell Oil*

A piggy-back steam tracer line made insulating asphalt pipelines at Shell Oil's Norco, La., plant a problem. Every foot of pipeline–if insulated in standard fashion–would have required insulation a size larger than normal. And there were miles of pipe involved.

Johns-Manville and its contract unit in New Orleans, McCarty-Branton, Inc., studied the problem and made an unusual recommendation. They suggested using elliptically shaped, "long-legged" Metal-On®, the aluminum-jacketed pipe insulation. This oval shaped pipe covering fit right over the asphalt pipes and the troublesome tracer line–and saved substantially in the cost of insulation.

Typically, Johns-Manville had the answer for this insulation problem. *Your* insulation jobs, too, will be solved best by Johns-Manville. For further information, write to J. B. Jobe, Vice-President, Johns-Manville, Box 14, New York 16, N. Y. In Canada, address Port Credit, Ontario. Worldwide, cable Johnmanvil.

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*Close-up of line section showing steam supply line and ½" copper tube tracer atop main line before it is coated with material used to bond it to main pipeline.*

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Please send me a sample of Metal-On

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## Selective-Sequence Controller

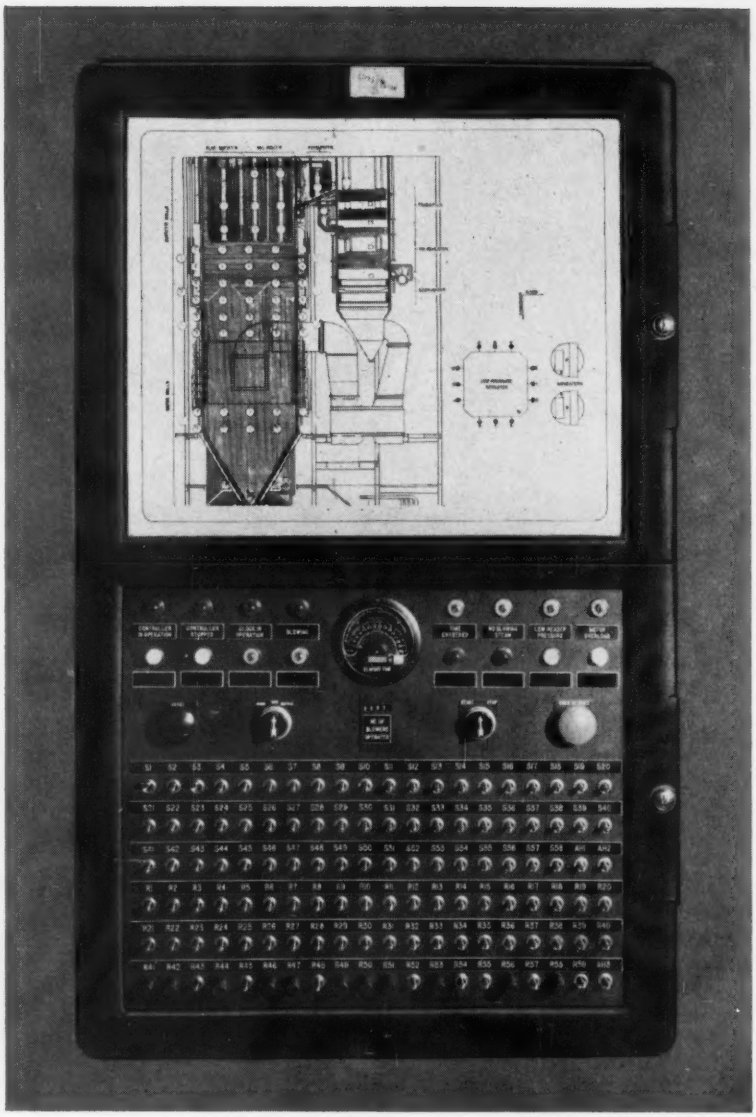
Up to 120 electrically-driven long retractable Vulcan soot blowers can be controlled by this SSC-120 controller. With it the operator can monitor the complete blowing program and get an instant report should there be any malfunction. In such case, interlocks automatically stop the blowing until a correction is made.

Vulcan Selective-Sequence control offers the greatest flexibility in automatic soot blowing. It permits varying the sequence by individual blowers — at any time, and in any way found desirable to improve boiler cleaning or to save blowing medium. Tied to a built-in clock, it permits 24-hour scheduling with three or more sequences.

**Vulcan Automatic-Sequential Control** permits the operator to pre-select any number of units to be operated individually — not necessarily by zones or bands. Without leaving the panel he can revise the sequence at any time, or switch instantly to single-unit operation.

**Both control systems** are described in Bulletin 1029. Write for it.

**With either system:** A new console-mounted miniature panel provides even greater convenience and efficiency. Soot blowing may be tied to some such phase of boiler operation as steam temperature control, a refinement with which Vulcan has had more than six years of experience. And for the ultimate in soot blower control, the Vulcan system can be tied in with computer operation of the plant.



# Vulcan "Automated" Soot Blowing

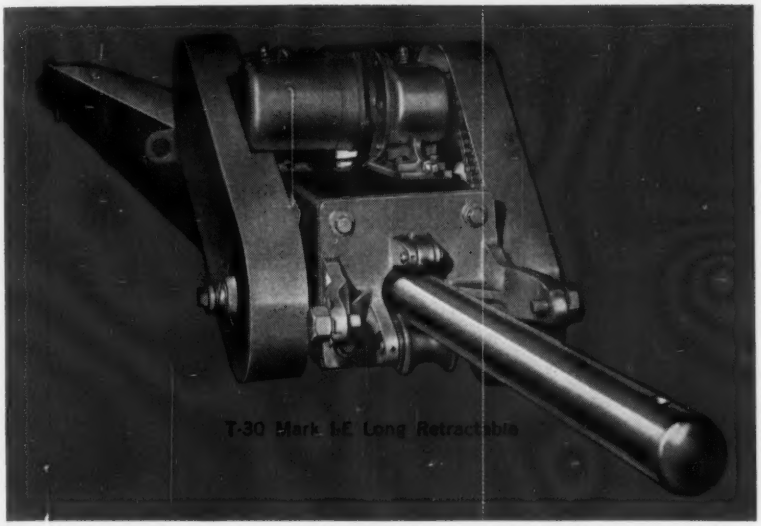
Modern boilers must be kept clean to operate efficiently—but the cleaning itself must be done efficiently to match modern operating procedures.

Vulcan precisely-controlled automatic soot blowing systems meet this specification.

**They save time.** One blower automatically follows another as programmed. Indexing is a matter of seconds.

**They save labor.** Merely pushing a button starts automatic operation. The operator or computer controls the whole system from one central location.

**They save fuel.** Cleaning is better because operation is positive and at proper intervals. Steam—which means fuel—and air are saved because of precise timing.



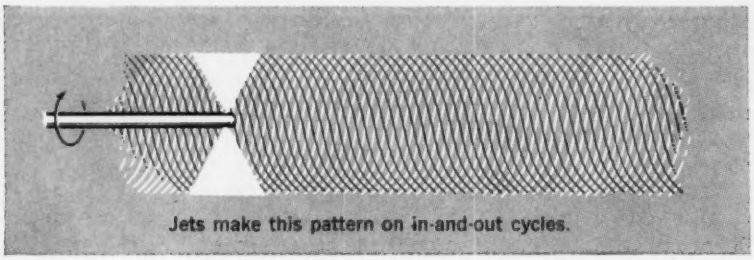

## Vulcan RW-3E Wall Deslagger

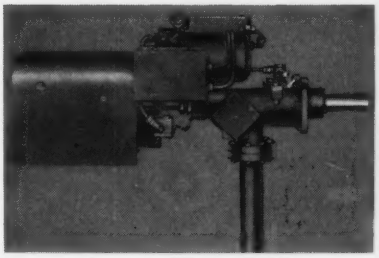
The high striking power of this electrically-operated deslagger drives off gummy, clinging masses or sintered ash to minimize average slag thickness. One motor extends and retracts the lance almost instantly. The other motor rotates the lance slowly for optimum cleaning. Air, saturated or superheated steam, or water—or any combination—can be used as the blowing medium. Blowing pressure may be adjusted while blowing. Maintenance is easy. Write for Bulletin 1034. Model RW-3A is air-driven. Write for Bulletin 1066.

## Long Retractable Soot Blowers

The electrically-driven T-30 Mark I-E is the most modern long retractable soot blower for travels up to 24 feet. It has dual-motor drive. One motor moves the lance in and out. This can be a 2-speed motor to save blowing medium. The other rotates the lance—always in the same direction. The special-alloy lance can be used in almost any temperature. Low rotating speed increases range and penetration of cleaning, decreases wear, and eliminates whip. Write for Bulletin 1063. The T-30 Mark I-A, Bulletin 1073, is air-driven. For travels greater than 24 feet, the Vulcan T-30, Bulletin 1030, is used.

**Rotary Soot Blowers** with electric, air or manual operation are available for use in lower-temperature zones. Write for Bulletin 1072.


Jets make this pattern on in-and-out cycles.



## Multi-Helix Jet Path

Because Vulcan long retractables have dual-motor drive, lance rotation is continuous with no stop-step action at the end of travel. The two jets always follow a different path in and out, forming an infinite number of reversed-helix paths on repeated cycles. This means thorough cleaning of all heating surfaces, minimized danger of tube erosion, and prolonged packing life.

# saves time, saves labor, saves fuel

**And maintenance is low.** Each component of a Vulcan system is designed with maintenance men in mind.

Write for the bulletins mentioned on these pages. Copes-Vulcan Division, Erie 4, Pennsylvania.

*Copes-Vulcan Division*

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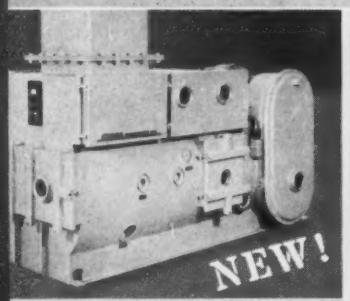
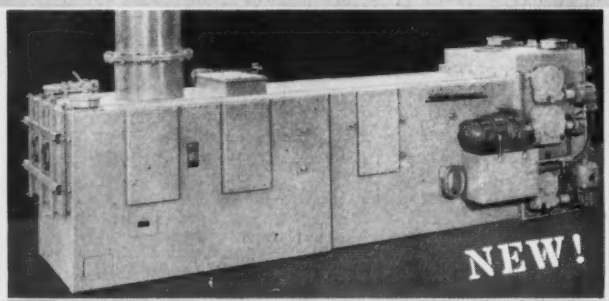
For more facts circle 209 on Reader Service card, p 121

Circle 210 on Reader Service card for following ad ➤

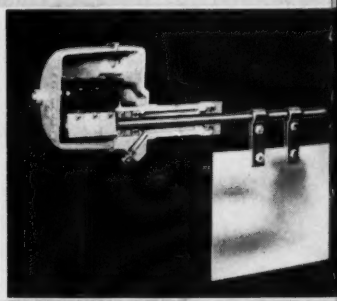
## S-E-Co. QUALITY PRODUCTS




GRAVIMETRIC FEEDERS
Weigh and Feed




VOLUMETRIC FEEDERS
Feed Sticky Coals



STOPPAGE ALARMS
Two Types

# S-E-Co. GRAVIMETRIC FEEDERS ALSO INDICATE COAL FLOW RATE AND TOTAL COAL

S-E-Co. Gravimetric Feeders for pulverizers or cyclone burners give reliable and useful indication of rate of coal flow and of total coal consumption.

The rate of coal flow through each feeder is determined by the speed of the head shaft. S-E-Co. Gravimetric Feeders discharge exactly 100 pounds of coal per turn of the head shaft, so the weight of coal per hour is directly proportional to RPM. The indicating instrument which is provided shows the coal flow rate directly in pounds per hour. A feed rate signal can also be supplied as required for recording instruments or for feedback into the control system.

Total coal flow is given by the number of revolutions of the feeder head shaft. The coal integrator is simply a counter driven by pulses taken from the head shaft. Absolute accuracy with no instrument drift is thus assured. The integrator reading times 100 is the total coal weight in pounds. The same pulse for every 100 pounds is ideally suited for entering coal flow information into data logging equipment. If preferred, pulses can be provided instead for any multiple or submultiple of 100 pounds.

S-E-Co. Gravimetric Feeders offer the instrumentation that helps attain the peak of perfection in plant operations. From indication of rate of coal flow in pounds per hour, exact balancing of fuel to each mill or cyclone is easily achieved. The instantaneous station heat rate can be determined quickly by a simple, *direct* procedure. Accuracy in the indication of total weight of coal burned means better records and hence better plant results, as well as proper maintenance scheduling. The advantages become even more pronounced with increasingly automatic control or with computer control.

One of the factors contributing to the precision of coal flow measurements with all S-E-Co. Feeders is their unusually high and non-varying volumetric efficiency. Regardless of whether your coal is wet and sticky, or dry and dusty, or frozen and full of lumps, the indication given of coal flow rate is consistent. With S-E-Co. Gravimetric Feeders, fluctuations in the coal density resulting from varying size consist, moisture, or compaction are eliminated.

**For further comments on plant operation with S-E-Co. Gravimetric Feeders, *send your inquiry to***

## STOCK EQUIPMENT COMPANY

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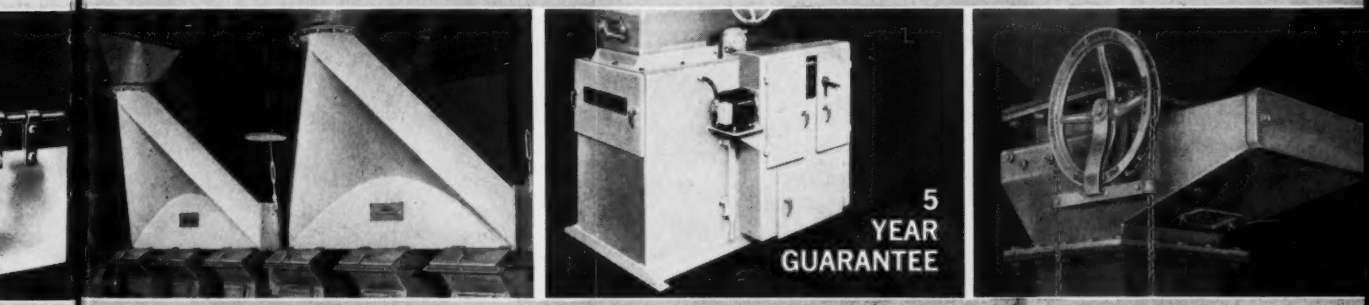
## S-E-Co. QUALITY PRODUCTS

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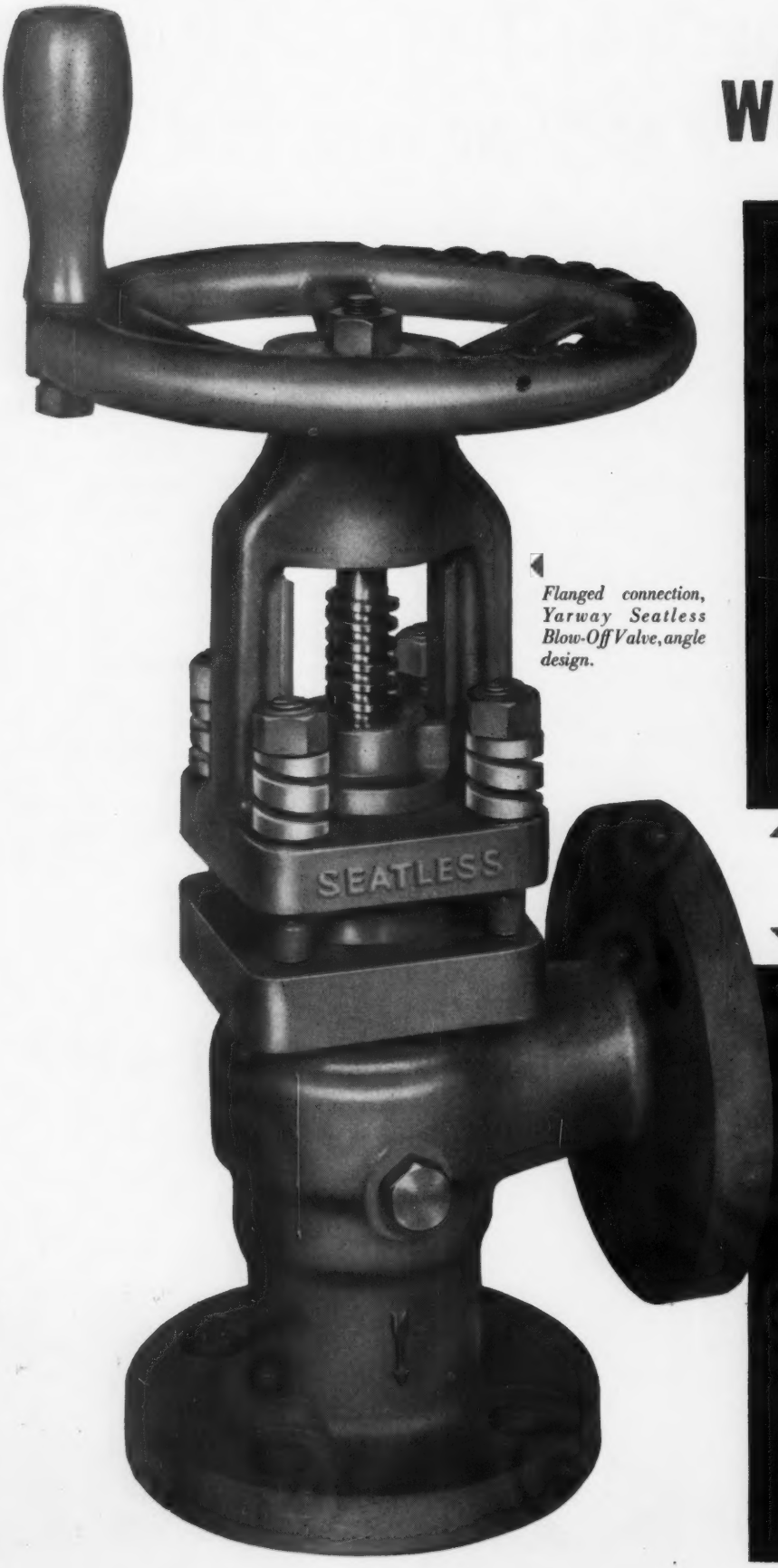
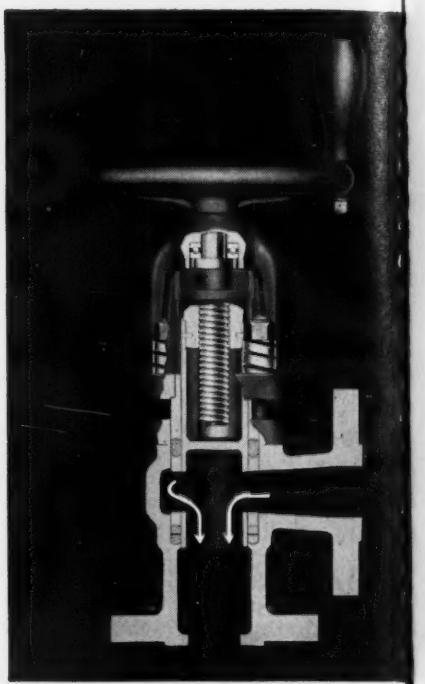
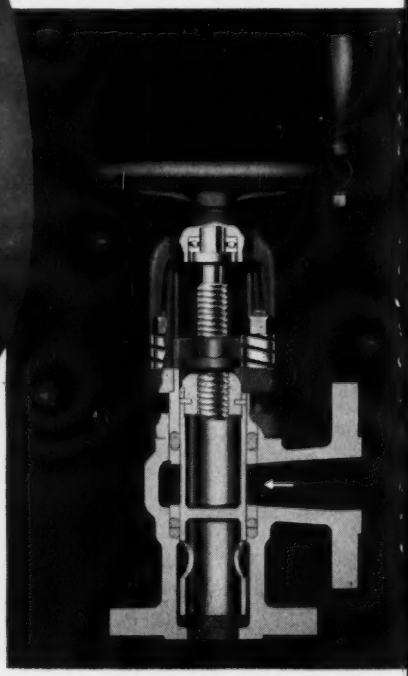



*Flanged connection, Yarway Seatless Blow-Off Valve, angle design.*



▲ *Yarway Seatless Blow-Off Valve in open position. Note full, free discharge.*

▼ *Valve in closed position. Note tight shut-off.*



# 16,000 engineers choose and use YARWAY SEATLESS boiler blow-off valves

## ■ SAVING IN MAINTENANCE COSTS
## ■ FREEDOM FROM BOILER OUTAGES

These are the reasons—proved again and again by engineers who know *performance*, in thousands of installations over the last 50 years. Yes, these are the reasons why *Yarway Seatless* has become virtually the "standard" on all low to medium pressure boilers today!

Check these features that are responsible for the acceptance of these time-honored but truly modern, compact valves:

■ **UNIQUE SEATLESS DESIGN** — full, free discharge . . . combined with drop-tight shutoff . . . and no seat to score, wear, clog or leak.

■ **BALANCED HOLLOW SLIDING PLUNGER** —made of nitralloy with a "glass hard" surface that resists erosion, high temperatures and sudden shocks. "Polishing" action lengthens life of packing rings.

■ **COMPRESSION YOKE SPRINGS** — heavy coil springs under yoke nuts maintain continuous pressure on reinforced packing above and below valve port to keep valve tight.

■ **BALL BEARING HANDWHEEL**—for smooth operation, easy opening and closing.

■ **NON-RISING STEM.** Valve cannot be opened or closed too quickly. Water hammer is prevented.

■ **STREAMLINED BODY AND YOKE.** Strength where strength is needed—without unnecessary bulk. "Compact" over-all design.

■ **CHOICE OF FIVE SIZES—1″ to 2½″,** angle or straightway designs, flanged or screwed ends, available in any tandem combination.

If you are planning purchase of a new boiler, or modernization of present boilers in pressure ranges up to 415 psi, *insist* on protecting your investment with new Yarway Seatless Blow-Off Valves.

They'll give you maximum dependability, minimum maintenance, and satisfaction that is beyond price—all at a very *low* cost per year.

Write for Yarway Bulletin B-427.

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*A MARK OF QUALITY IN STEAM ENGINEERING*


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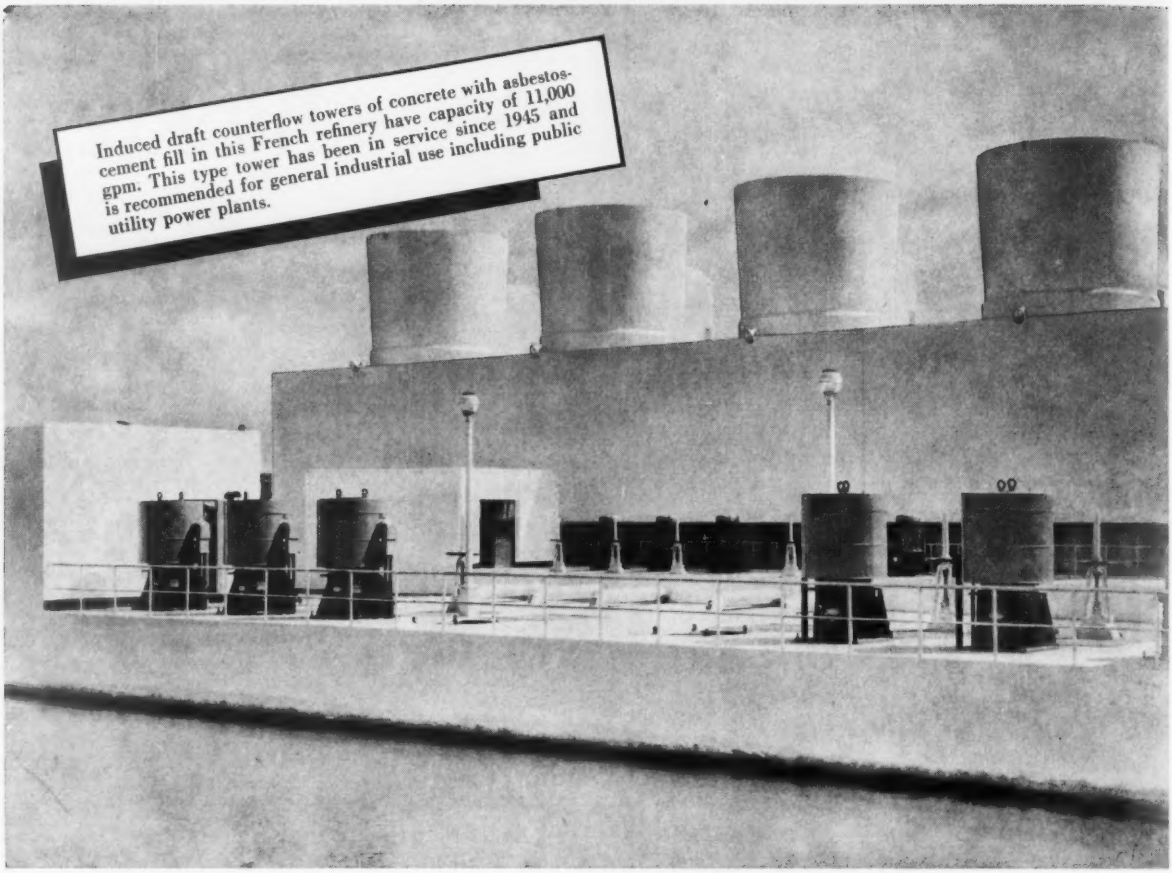


Induced draft counterflow towers of concrete with asbestos-cement fill in this French refinery have capacity of 11,000 gpm. This type tower has been in service since 1945 and is recommended for general industrial use including public utility power plants.

# For your next cooling tower take a close look at concrete construction with asbestos-cement fill

*(one of a series)*

- **maintenance cost is virtually zero**
- **service life is long — more than 40 years**
- **water treatment is greatly simplified**

**HAMON recommends asbestos-cement fill**

Potential savings are substantial and tower operation is less complex. With over sixty million square feet of asbestos-cement fill in operation, Hamon has a unique background of experience with cooling tower materials to place at the disposal of users

Cooling towers made of concrete with asbestos-cement fill have many worthwhile advantages over those constructed wholly or partly of wood. First report in this special advertising series, December 1960 POWER, pages 48, 49, explains why Hamon recommends asbestos-cement fill for the greatest return on your investment in cooling towers. This second report explains why control of water treatment is more critical in wood than in concrete towers with asbestos-cement fill.

Independent investigations show that chemical and biological attack are responsible for the relatively high maintenance and short life experience of wood in cooling towers. The main advantage of asbestos-cement is extremely long life, certainly well over 40 years, almost without maintenance. Of course, some maintenance is involved on the mechanical equipment. But the amount is much less than on conventional induced-draft cooling tower designs.

Cooling towers constructed of wood cannot be expected to give the same long life. This is very evident from studies made by the Cooling Tower Institute and the California Redwood Association. Their published report is based on a survey of 103 cooling towers covering the years from 1951 to 1958. This accumulated data on the life of wooden cooling towers is extremely valuable.

## Average Life of Wood Filling

Table I in this survey, CTI bulletin WMS-104, dated June 1959, gives the age of cooling-tower parts at the time of replacement. From this data we calculate that the average life of wood filling in the survey is about 12.5 years. Many of the towers had received the benefit of improved-water, and/or wood-treatment during the test period.

It is generally accepted that the analysis of the circulating cooling water must be carefully controlled to prevent rapid attack of wood. Bulletin No. 2173 of the U. S. Forest Products Laboratory, Madison, Wisconsin, gives the results of tests on the life of redwood blocks in operating cooling towers. In this study over 80 separate fungi from operating towers were examined in detail.

## Operating Tests on Redwood

Table 5 in this report tabulates the weight-loss of redwood blocks after exposure to these fungi under various operating conditions. Fresh redwood blocks showed no weight-loss after nine months exposure. Similarly, redwood blocks that were prepared by leaching in warm water suffered no weight loss over the same period. In the third series of exposures redwood blocks were prepared by first leaching them in warm water containing two ppm available chlorine. All but one of the 83 fungi in the series produced substantial weight loss in these chlorine-treated redwood-blocks.

**Water distribution system** in this natural-draft cooling tower is constructed of asbestos-cement pipe. The hot water returns are evenly distributed over top of the cooling tower fill.

General conclusions of the cooling tower study, page 5 of the CTI bulletin, include recommendations for water treatment. According to CTI: "It is quite apparent after seven years of continuous study that proper treatment of the circulating water is effective in reducing both chemical and biological attacks." This means: (1) Keeping carbonates and bicarbonates as low as possible with pH between 6 and 7. (2) Using non - oxidizing algaecide - fungicides since too much chlorine aggravates chemical attack. (3) If chlorine is employed use intermittently and maintain less than 1 ppm residual in the hot water. (4) Avoiding high pH and high-chlorine residuals since this combination accelerates attack on wood. (5) Adding chromate to help prevent biological surface attack. Low pH-chromate treatment also helps prevent chemical surface attack. Water treatment must protect the metal parts in addition to preventing attack on the wood.

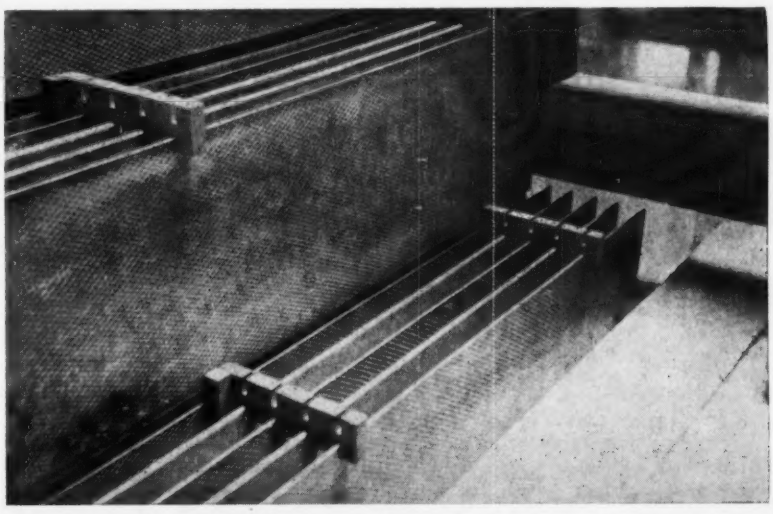
This greatly complicates the problem and makes the treatment more expensive. For example, low pH may not be needed to prevent scaling, but is required to protect the wood. Low pH also tends to promote corrosion in the metal parts of the system. Therefore the circulating water must be treated with considerable care to prolong wood-life without damaging metal parts of the tower and related equipment.

Close control of pH is difficult particularly when operating conditions fluctuate. Certainly, it would be simpler and less costly if complex treatment could be avoided by the use of a less sensitive tower material. If there is no fear of destroying wood, treatment often might be limited to a small amount of scale inhibitor such as a synergized polyphosphate. In some cases the use of an algaecide is all that is required

## Tower Fill and Water Treatment

Water treatment is very simple to control on this basis and is extensively employed in the USA and in Europe. Metal parts in the recirculating system have been successfully protected, but this type of treatment has not been able to prevent considerable damage to wood cooling tower parts.

Biological surface attack is the source of considerable wood damage and is termed "soft rot." The growth of "soft rot" is promoted by the atmospheric conditions in the equipment. The steady air flow through the tower provides oxygen. Temperature approaches the



**Asbestos cement** fill in natural draft cooling tower rests on reinforced concrete beams

(*Advertisement*)

# Hamon recommends cooling towers of concrete with asbestos-cement fill

**Interior** of tower has concrete framework with asbestos-cement splash board design

optimum needed for the development of these organisms (ascomycetes). Finally the phosphates contained in the chemicals used to treat the water accelerate the rate of growth.

Delignification of the wood is actually a chemical attack caused by the oxidizing elements and alkalies present in the circulating water. This kind of deterioration promotes additional fungi attacks. Chemical impregnation treatment of the wood certainly doesn't prevent this chemical attack. Therefore it doesn't offer permanent protection against the biological attack either. The protection it affords lasts only as long as the water is properly treated to prevent chemical attack of the wood.

Biological internal attack or "internal rot," caused by other fungi (the basidiomycete group), is not as common as surface-biological attack. But it is equally dangerous. The appearance of this attack is haphazard and hard to detect. The surface often appears quite sound. But the defective area can be pierced easily with a sharp probe. This must be tried in the areas suspected of developing internal rot.

## Cooling Tower Materials

The Hamon Company has specialized in cooling tower design and construction for over 50 years. Based on experience with all types of materials they realize, along with other builders, that wood is not the most reliable material for cooling towers. The many difficulties encountered have already been cited. Treatment of the circulating water is critically important in order to give the wood lasting protection.

Spurred by the high maintenance expense of wood towers, the Hamon Company has designed and constructed numerous towers over the last 20 years with concrete structures and asbestos-cement fill. After long experience with wood and asbestos-cement many organizations now use asbestos-cement only. For example the French Power Authority "EDF" and the nationalized French Coal Mines have practically standardized on large concrete towers with asbestos-cement fill. The same holds true for the Central Electricity Board in England.

## Advantages of Asbestos-Cement

Tower installations without wood have practically zero maintenance (except for metal parts) and expected life is extremely long. Treatment of the recirculating water is very much simpler. The asbestos-cement is definitely not harmed by alkaline water, carbonates or bicarbonates. Chlorine and its derivatives can be used as needed without fear of damaging the fill.

The advantages of asbestos-cement cooling tower-fill from a water treatment standpoint include: (1) Adjustment of the pH is not specifically required to protect the asbestos-cement fill. A scale inhibitor can be used, if needed, to protect the metal parts of the circuit. (2) If the stability index of the water allows a relatively high pH, it can be maintained without harming the filling. (3) Makeup water can be softened in a sodium zeolite softener although this increases the sodium carbonate and sodium bicarbonate content of the recirculating water. (4) Concentration of sodium salts in the circulating water can reach very high levels without adversely affecting the asbestos-cement. This may allow a substantial reduction in blowdown, makeup and the cost of water treatment. (5) Chlorination, the most economical way to combat algae, doesn't damage the filling. This avoids the use of special-algaecides that are often more toxic and more expensive.

## Conclusions

To summarize; the substitution of reinforced concrete and asbestos-cement fill for wood tower construction greatly simplifies equipment maintenance and the problems of water treatment.

The potential saving in both these areas is substantial. Tower operation is less complex and life of the equipment is considerably lengthened. With sixty-million square feet of asbestos-cement fill in actual operation, Hamon, Inc., has a unique background of experience with this durable material to place at the disposal of U. S. tower users.

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- ☆ Société Hamon
  7, rue de la Tour des Dames, Paris 9 ème, France
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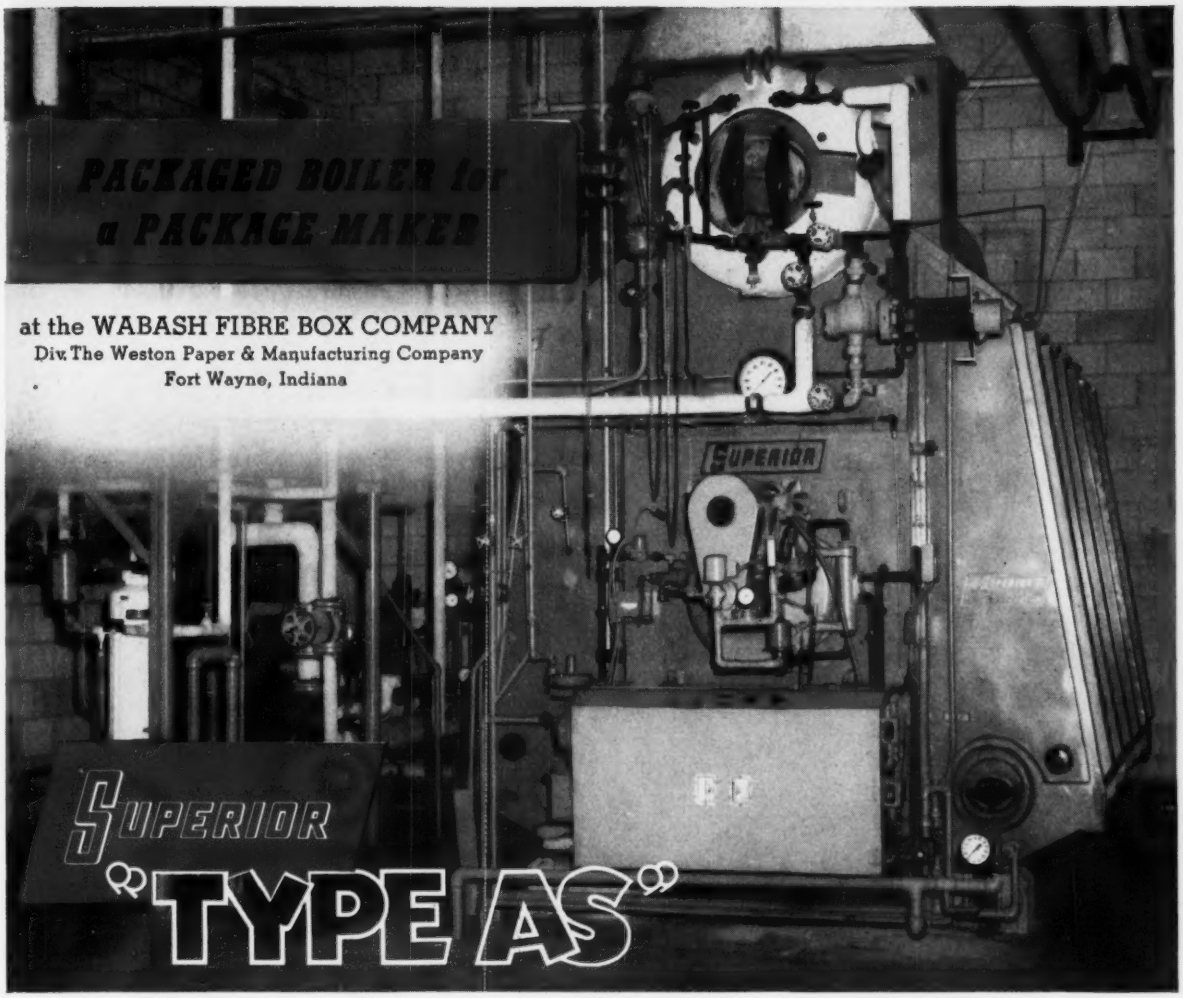


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Note in this Type AS installation, the uncluttered firing front . . . result of rear-mounted draft fan and soot blowers. Note controls at floor level, affording accessibility without need for ladders or platforms.

The boiler's baffleless design (unusual in boilers of this capacity) results in complete freedom from dangerous gas pockets. With its Superior Rotary Burner, maximum safety and efficiency for fully automatic operation are assured.

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Almost 2,000 feet of Saran Lined Pipe, fittings and valves will carry non-radioactive acid solutions and sodium hypochlorite at Indian Point Station, N. Y., Consolidated Edison Company's atomic power plant.

Saran Lined Pipe has the combination of chemical resistance and structural strength which severe service conditions of this type require, and it has been estimated that Saran Lined Pipe may give as long as 25 years of trouble-free service.

At Indian Point Station, Saran Lined Pipe was installed by an independent engineering firm. Project engineers point out that another advantage of this corrosion-resistant piping system is its ease and economy of installation. Crews easily cut and fit pipe without expensive prefabrication, without breakage, and using standard tools and equipment.

Saran Lined Pipe, fittings, valves and pumps are available for systems operating from vacuum to 300 psi, from below zero to 200°F. They can be cut, fitted and modified easily in the field without special equipment. For more information, write Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale, Michigan, Dept. 1573DW6.

**THE DOW CHEMICAL COMPANY** DOW Midland, Michigan



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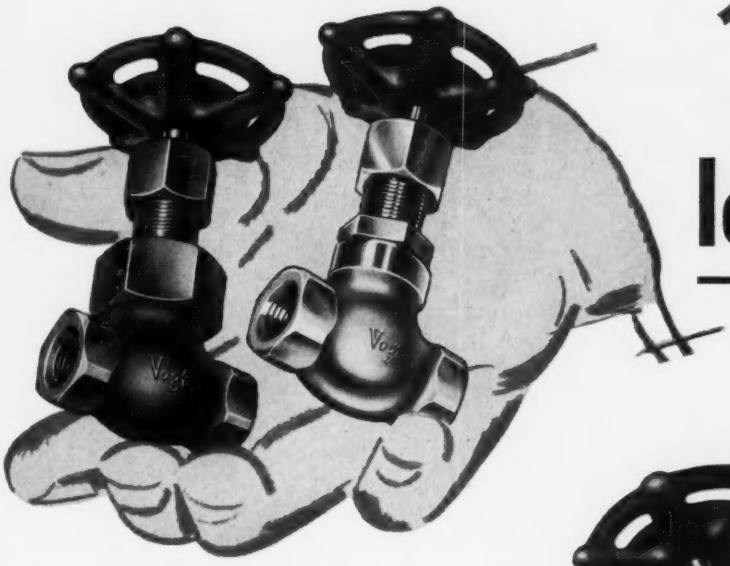

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Service proved — these valves have always been a standard of quality for meter and gauge line service. You no longer need to compromise for less because of price! Send for Folder GP-9 giving specifications and engineering data on both globe and angle types, forged from stainless or carbon steel for every meter and gauge line service.

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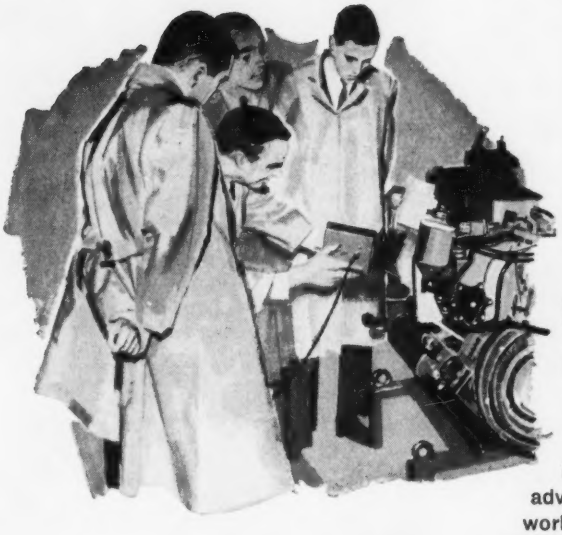

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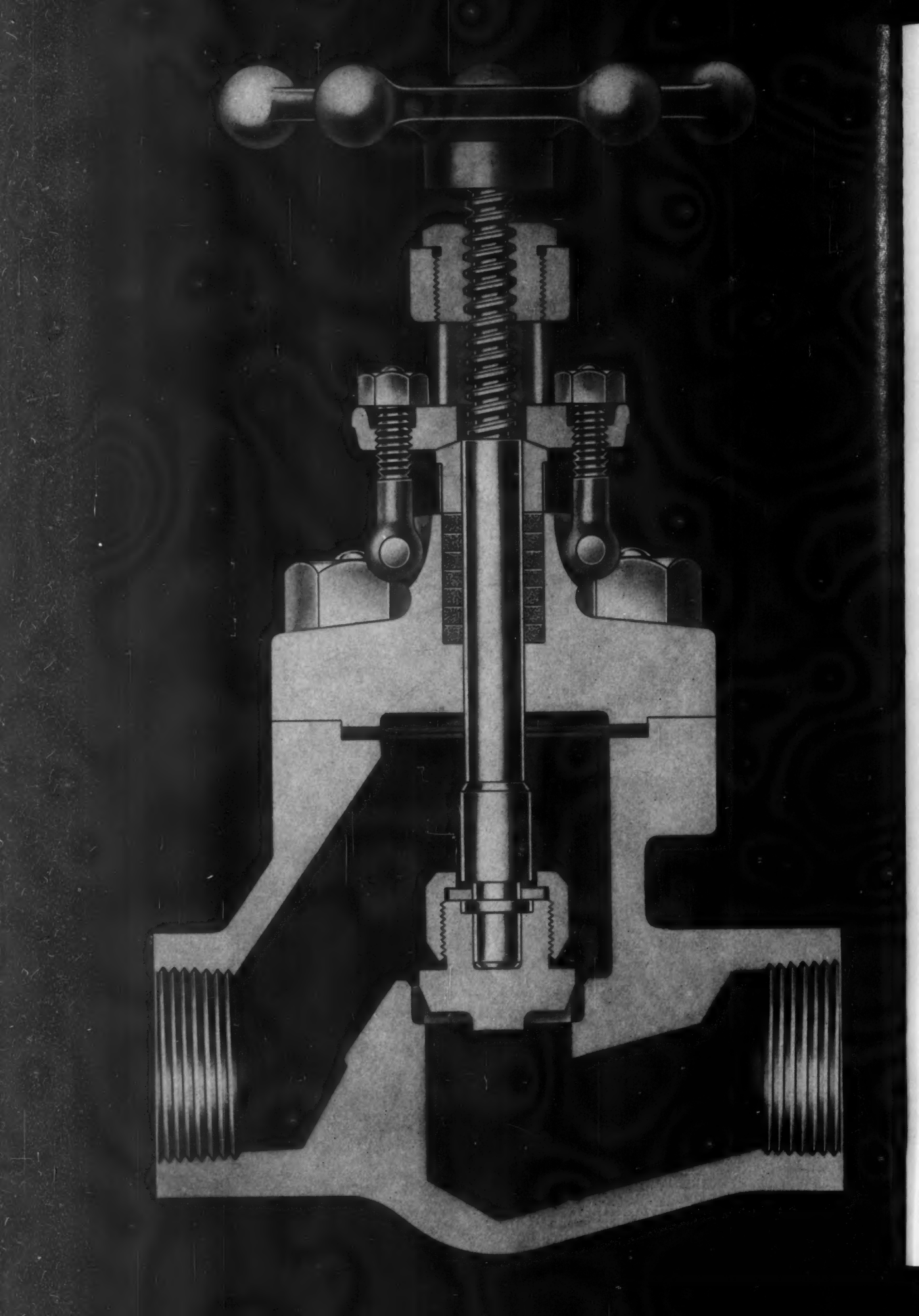

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The valve illustrated at the left is the Hancock Type 5500 Steel Globe Valve widely used for all types of industrial plant services.

*For technical assistance in selecting quality Hancock Steel Valves, phone your industrial supply distributor or write for Catalog 200A.*

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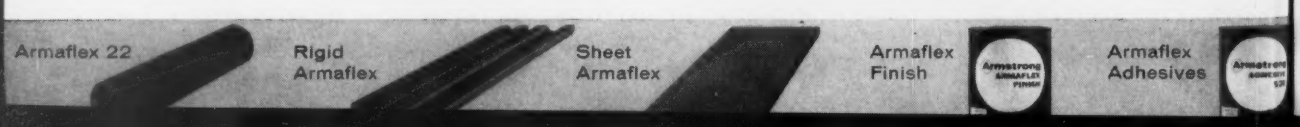


*wherever water treatment is used*

# *the leaders look to* MOGUL *for results*

Eitel-McCullough, Inc., San Carlos, California is a leading producer of electron-power tubes. They manufacture Amplifier Klystrons, Microwave Devices and Negative Grid Tubes. Eimac products are used in rf power applications in broadcasting, industry and our nations defense systems.

This modern, highly scientific West Coast firm has chosen MOGUL to protect their water using equipment. MOGUL water treatment products are used in high pressure boilers; cooling towers; air conditioning systems; steam and condensate lines . . . and even in production facilities . . . acid scrubbers and water wash paint spray booths use MOGUL.

Why not consider MOGUL-IZING your plant? It can return big dividends in performance results . . . complete literature is available.

MOGUL

Standard Building • Cleveland 13, Ohio

SPECIALISTS IN INDUSTRIAL WATER TREATMENT FOR OVER 44 YEARS

◀ Circle 218 on Reader Service card, p 121

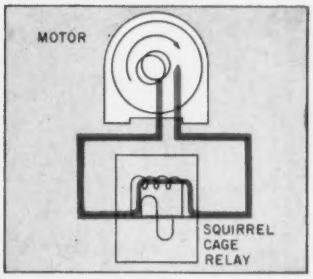
For more facts circle 219 on Reader Service card, p 121

# Start-up . . . running . . . shutdown . . .
# Only General Electric offers full-time motor

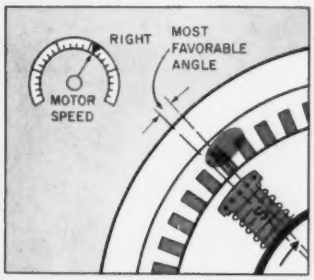
LOW- AND HIGH-VOLTAGE STARTERS FOR PUMP AND COMPRESSOR MOTORS

## SYNCHRONOUS MOTOR CONTROLS

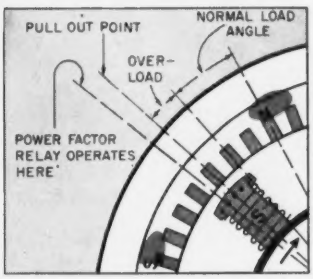
# or protection, maximum power use




**At low speed, SCR heater "sees" current proportional to that in winding. As speed increases, current is proportionally shunted around heater, giving protection at all speeds.**




**When motor speed and load angle are correct, field-application relay applies field excitation; synchronizes motor under most favorable condition.**




**Power-factor relay monitors angle between rotor and stator poles. As rotor starts to slip, angle causes the flux to stretch. Relay removes field within first half-slip-cycle.**

At start-up . . . while running . . . at shutdown . . . General Electric synchronous motor controls safeguard equipment from "burnout" and permit full-time use of *all* the power capability of your motors. Only General Electric offers a control precisely combining all key factors in top synchronous performance:

**GRADUATED SQUIRREL-CAGE PROTECTION** results from the use of an ambient-compensated thermal relay placed in the field-discharge circuit. This thermal relay monitors the temperature of the squirrel-cage winding . . . constantly protecting the motor from overheating at all speeds, and allowing it to operate safely under all starting conditions.

**PRECISION-ANGLE SWITCHING** applies field excitation at exactly the right moment to take full advantage of the motor's pull-in torque. The result: synchronization on the first attempt! This means maximum use of power, without repeated attempts to pull in, excessive motor stress, and other harmful effects.

**SPLIT-SECOND FIELD REMOVAL** system cuts off excitation immediately—within the first half-slip-cycle—in case of excessive load torque, line or excitation-voltage fluctuations. Thus, damage to motor pulling out-of-step is virtually eliminated.

Get full value from the next motor you buy . . . start, run, and protect it with a versatile General Electric Synchronous Control. Call your G-E Sales Representative. Or, write Section 783-21, General Electric Co., Schenectady, N. Y., for Bulletin GEA-5873. *Industry Control Dept., Salem, Va.*

**SYNCHRONOUS MOTOR FIELD CONTROL**

| | General Electric | Company "A" | Company "B" |
|---|---|---|---|
| Graduated Squirrel-cage protection | Allows maximum motor utilization and protection at all speeds. | Prohibits maximum utilization of motor. | Satisfactory, but lacks precision. |
| Precision-timed field application | Selects both speed and most favorable rotor angle. Synchronizes on first attempt. | Avoids most favorable angle. Dissipates synchronizing ability of motor. | System lacks precision in finding favorable angle. |
| "Split-second" field removal | Field excitation is completely removed within the first ½ slip-cycle. | Motor speed must drop significantly before field is removed. Requires several slip-cycles. | Slip may be as high as 6% before field is removed. Does not assure protection. |

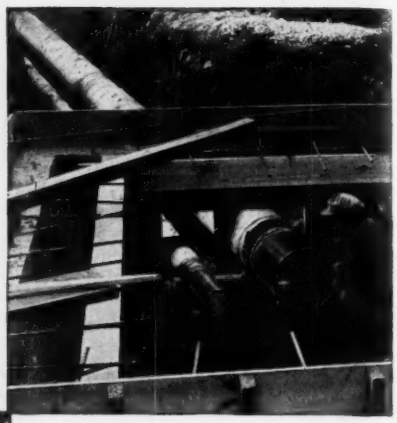
*Progress Is Our Most Important Product*

GENERAL ELECTRIC

*MR. ENGINEER:*

*LET'S FACE THE FACTS . . .*

# Can you be sure your underground piping system is watertight if you can't *AIR TEST* it?



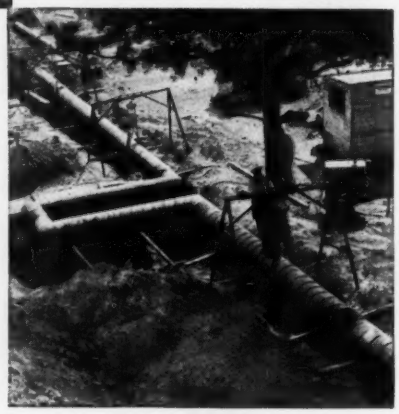
Test caps applied to unit ends for air testing full-welded conduit system.

During air test, conduit field welds are checked with soap solution.

***WITH***

# RIC-WIL

Tested and ready for lowering long lengths.



## *YOU can AIR TEST your system...*

**The Ric-wil method of making full-welded field closures allows the installer to AIR TEST the system prior to completion and backfilling. This simple 15 lb. pressure test gives greater assurance of a tight, leak-proof system. It provides the finest practicable protection to the owner against an initial system failure ...and most important, the long range effects of water corrosion.**

**Ask a Ric-wil field representative for detailed information regarding Air Test procedure or write for catalog covering recommended field installation details . . . and remember, it pays to do it RIGHT the first time . . .**

*Quality Piping Systems . . .*
*. . . of Exceptionally High Thermal Efficiency*

RIC-WIL PREFABRICATED INSULATED PIPING SYSTEMS

CENTRAL OFFICE: RIC-WIL INCORPORATED, BARBERTON, OHIO
WESTERN STATES: RIC-WIL INCORPORATED, WESTERN DIVISION, NEWARK, CALIFORNIA
IN CANADA: THE RIC-WIL COMPANY OF CANADA LIMITED



For more facts circle 221 on Reader Service card, p 121

# STEPHENS-ADAMSON

## BELT CONVEYOR SYSTEMS

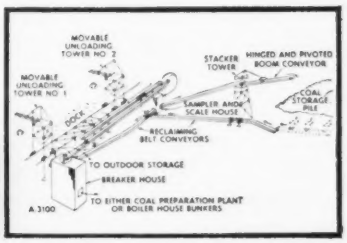
**provide maximum efficiency in converting coal to kilowatts**

Maximum efficiency in converting coal to kilowatts is attained through the use of STEPHENS-ADAMSON Belt Conveyor Systems. Unloading, storing, crushing, reclaiming, sampling and distribution functions are all accomplished by S-A Belt Conveyor Systems. Coal moves to any desired point in a continuous, uninterrupted flow. Tonnage handled is increased while handling costs are cut to the lowest cost per ton. Quality Belt Conveyor System components backed by 60 years of bulk handling experience assure minimum "downtime," minimum maintenance and years of dependable service. Write for full details today.

**S-A BELT CONVEYOR SYSTEMS HANDLE COAL AT LOWEST COST PER TON!**

STORAGE—S-A Belt Conveyor Stacker handles storage pile operation

RECLAIMING—S-A Belt Conveyors move coal from storage to bunkers




Typical power plant, coal handling, belt conveyor system.

**WRITE FOR LITERATURE**

S-A
ENGINEERED BULK HANDLING SYSTEMS
MATERIALS HANDLING PRODUCTS
SPEEDWALK® PASSENGER CONVEYORS
SEALMASTER® BALL BEARING UNITS
SPHERCO® BEARINGS & ROD ENDS

ENGINEERING DIVISION

**STEPHENS-ADAMSON MFG. CO.**

GENERAL OFFICE & MAIN PLANT, 5 RIDGEWAY AVE., AURORA, ILL.

PLANTS LOCATED IN: LOS ANGELES, CALIF. • CLARKSDALE, MISS.
BELLEVILLE, ONT. • MEXICO CITY, D. F.

For more facts circle 350 on Reader Service card

circle 351 on Reader Service card for following ad ➧

# Compact...Powerful...

## FISHER
*SERIES*
## 470 P.O.P.
*PNEUMATICALLY OPERATED PISTON*

**SPLIT BODY CONSTRUCTION**

Type 470-Z Actuator with a Split body. P.O.P. is also ideal for three way bodies and large single port globe or angle bodies. Only Fisher gives you such a wide selection of actuator-body combinations.

# ...Piston Actuator for Control Valves

## *does jobs that once required giant size equipment!*

***POWER***—Thrusts up to 17,500 pounds available. Delivers same power in either direction at any point of the stroke.

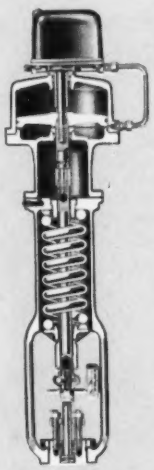
***ACCURACY***—Maximum Hysteresis 0.15% of stroke or signal. Repeatability 0.03% of stroke or signal. Resolution Sensitivity 0.02% of instrument signal.

***SPEED***—4 inches per second stroking speed with the Size 30. Size 60 provides 1.5 inches per second.

***STABILITY***—Built-in intermediate feedback causes proportional band of positioner to be broad while instrument changes are taking place, yet narrow when unit is not in motion.

Here's power plus in a small package! This compact Fisher 470 Series has its own positioner mounted integrally on top of the cylinder. Positioner receives any of the normally used pneumatic instrument signals. Then, without an air set, actuator utilizes the full potential of the available air or gas supply (up to 150 psi) to provide exceptional speed and power.

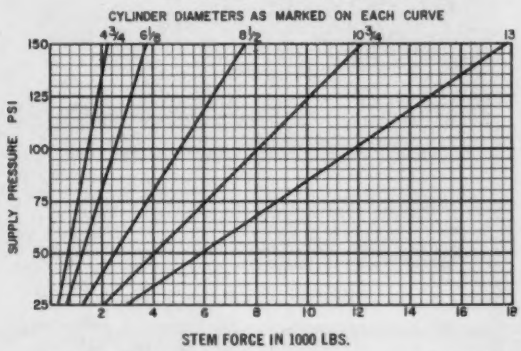
Series 470 is adaptable to virtually all types of valve bodies including butterfly valves. Easily reversible actuator can be changed in the field. Available in six basic sizes and can be supplied for travel up to 4". Basic actuator can also be furnished with a handjack, hydraulic snubber, pneumatic safety devices or as a spring return unit . . . **Write for Bulletin E470.**



### BRACKET MOUNTED SERIES 480 P.O.P.

**The versatility of Fisher's P.O.P. actuators is further highlighted in the bracket mounted Series 480. The Series 480 provides a compact, powerful actuator for the operation of butterfly valves, louvers, large rheostats and similar equipment found in many industrial applications.**

### AVAILABLE STEM FORCE




**Besides the five basic sizes shown by the curves, a 17 inch cylinder can be supplied to provide thrusts of 12,000 pounds with a supply pressure of only 60 psi.**

### SPRING RETURN ACTUATOR

Type 473 Actuator with spring safety device. In event of a supply pressure failure control valve will move into the closed position. Also available with spring for return to open position in event of plant air failure.

IF IT FLOWS THROUGH PIPE ANYWHERE IN THE WORLD . . . CHANCES ARE IT'S CONTROLLED BY . . .

**FISHER GOVERNOR COMPANY**

*Marshalltown, Iowa / Woodstock, Ontario / Rochester, England*

BUTTERFLY VALVE DIVISION: CONTINENTAL EQUIPMENT COMPANY, CORAOPOLIS, PA.

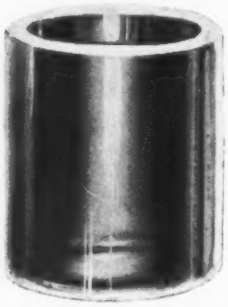
FISHER® Controls

SINCE 1880

# CORNING INDUSTRIAL GLASSWARE FOR EVERY JOB

Name your problem, and there's a Corning Industrial Glass Product to fit it. They're stocked locally, too, by most industrial distributors and mill supply houses. Carefully engineered, they are designed to withstand temperature change, mechanical shock, corrosion, and every hazard they'll be exposed to. You've a wide selection, too. Sight glasses, for example. They're made for temperatures up to 500°F, pressures up to 300 psi. But don't wait for emergencies to threaten production, create unnecessary down time. Stock up with replacements now . . . at least *three* for each installation. Then you'll be sure.

*Lubrication inspection*



*PYREX® Lube Glasses*

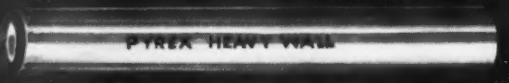
*Up to 100 psi*

*Corning® Standard Gauge Glasses*

*Extra visibility*

*PYREX® Red-Line Gauge Glasses*

*Higher pressures*




*PYREX® Heavy-Wall Gauge Glasses*

*Higher temperatures*

*PYREX® High-Pressure Gauge Glasses*

*Heavy duty*

*Macbeth® Flat Glasses*

*Furnaces, reactors, pressure vessels*

*PYREX® Sight Glasses*

*Visible discharge*

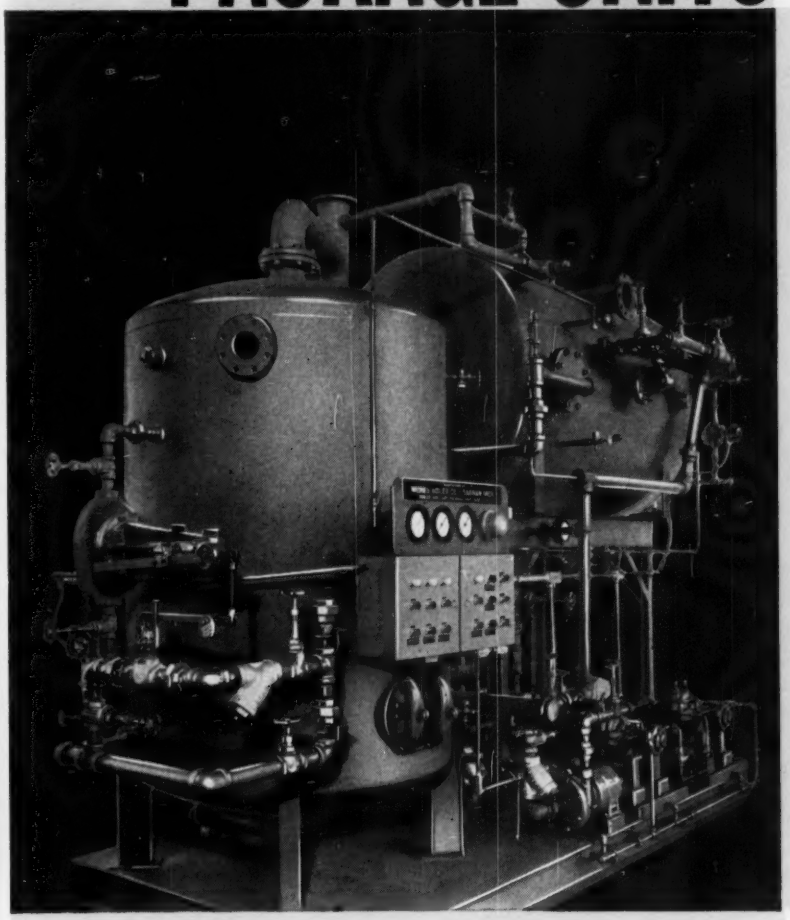
*PYREX® Oil Cup Glasses*

**CORNING GLASS WORKS**

CORNING MEANS RESEARCH IN GLASS

# WICKES BOILER AUXILIARY PACKAGE UNITS

*standard*



**Save On First Cost • Engineering • Building Space • Construction Time • Operating and Maintenance Cost**

Wickes Boiler Co. now offers a packaged system of various compact combinations of DEAERATING FEED WATER HEATERS, BOILER FEED PUMPS, CONDENSATE SURGE TANKS and BLOW-OFF TANKS. Standard units available for steam plants of 10,000 to 100,000 lbs. of steam per hour capacity and steam pressure to 300 PSIG. Information on special units of higher capacities and pressures upon request. Each unit is shop-assembled on a structural steel base, completely piped and wired and equipped with all necessary controls and an instrument panel.

173

Write today for Bulletin 59-1, which gives detailed engineering information on all three models of Wickes Boiler Auxiliary Package Units.

**WICKES BOILER CO., SAGINAW 10, MICHIGAN**
*Division of The Wickes Corporation*

**WICKES**

*RECOGNIZED QUALITY SINCE 1854*

**SALES OFFICES:** Atlanta • Boston • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New Orleans • New York City • Philadelphia • Portland, Ore. • Rochester, N. Y. • Saginaw • San Francisco • Seattle, Wash. • Springfield, Ill. • Tulsa

COPPUS | BLUE RIBBON PRODUCTS

Coppus Steam Turbine with Built-In Speed Reducer

***STAMINA*** — You can literally *see* stamina in every dimension of a Coppus Turbine . . . rugged reliability that assures you stable, positive performance. It truly "wins" the Blue Ribbon with which it is marked . . . through advanced design, top quality materials, and thorough testing. With Coppus you're always certain of Blue Ribbon features such as these —

*A totally enclosed governor . . . totally enclosed, independently operated safety trip . . . easily replaceable packing and bearings . . . multiple steam nozzle control . . . brake rim for added safety . . . wide bucket "L" type wheel (optional) for minimum water rate.*

Coppus Turbines are built to customers' specifications, including API and NEMA standards. Sizes from 1 HP to 250 HP. All Coppus Products carry the same Blue Ribbon assurance of reliable performance. For further facts on turbines, send for new Catalog 200. COPPUS ENGINEERING CORPORATION, 166 Park Ave., Worcester, Mass. Sales Offices in *Thomas' Register*.

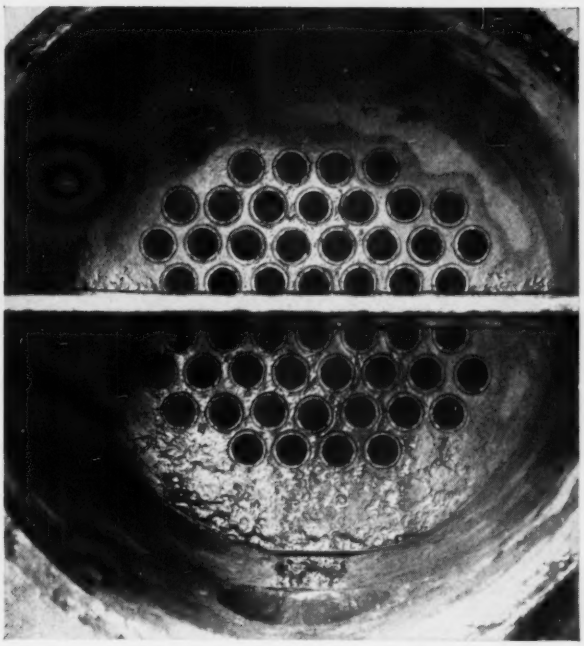
**COPPUS**
**STEAM TURBINES**



For more facts circle 223 on Reader Service card, p 121

# Descale equipment quickly, safely, —without dismantling!

**BEFORE**—This condenser was badly clogged with hard-water scale. Mechanical cleaning of the tubes would have been difficult, time-consuming and costly. To use hydrochloric acid would pose danger to nearby equipment and personnel.



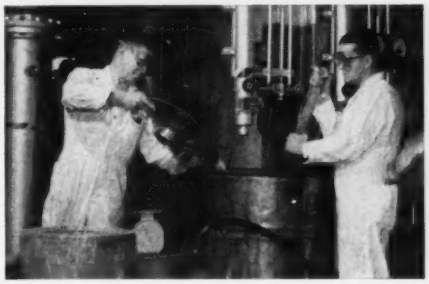
**AFTER**—It was easily cleaned *without dismantling* by circulating a water solution of a sulfamic acid-based cleaner for an hour. Short downtime, *no* danger to equipment and complete safety for personnel!

## Use a dry-acid cleaner based on Du Pont Sulfamic Acid

**They're effective.** Dry-acid cleaners dissolve most water-side deposits found in condensers, boilers, compressor jackets, heat exchangers, etc. Yet they're much less corrosive to metal than hydrochloric-acid cleaners.

**They're easy, safe.** Just dissolve the solid cleaner in water and circulate through the equipment. No danger of broken carboys, spilled liquids or toxic fumes—glasses and gloves are the only protective clothing needed!

**They're economical, fast.** 1 lb. of dry cleaner does the job of 1.3 lb. of 28% hydrochloric acid—you save on shipping, handling, storage and downtime (because there's no dismantling).



Horizontal and vertical condensers, stills, compressors, etc., are readily and economically descaled in place with cleaners based on Du Pont Sulfamic Acid. Plant personnel do the job with a minimum of equipment.

Ask your water-treatment company's technical representative about dry-acid cleaners; chances are, he can supply you. Or send the coupon for booklet and names of formulators offering dry-acid cleaners based on Du Pont Sulfamic Acid.

DU PONT
REG. U. S. PAT. OFF.
BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

E. I. du Pont de Nemours & Co. (Inc.)
Industrial and Biochemicals Department, N-2545P,
Wilmington 98, Delaware.

Please send your "Descale" booklet and names of formulators offering cleaners based on sulfamic acid.

*Name* _____

*Company* _____

*Address* _____

*City* _____ *State* _____

961

**For more facts circle 224 on Reader Service card, p 121**

**Circle 225 on Reader Service card for following ad ➤**

## ALL SIZES, ALL BODY PATTERNS FOR ALL APPLICATIONS

**BALANCED VALVES**
— for air, steam, water, gas. Designed for applications where close control is required, where pressures exceed those of single-seated valves, and where tight closing is not required. Double-seated construction, approximately 98% tight closing. Sizes ½" to 14". Wide choice of models, capacities and operating features.

**COIL VALVES**
— for medium pressure steam, liquid, air or gas. Long-life molded rubber diaphragms. ½" to 6" sizes. Body patterns and features for many applications.

**CONVECTOR VALVES**
Compact size for installation in confined spaces, inside or outside convector enclosures. Models for low pressure steam, hot and cold water. All models have "Sylphon" metal bellows operators. Sizes ½" and ¾".

**LIQUID VALVES**
— for low pressure hot or cold water service. Choice of molded rubber diaphragms or seamless "Sylphon" bellows. Removable tops. Wide choice of features and body patterns. Sizes ½" to 8".

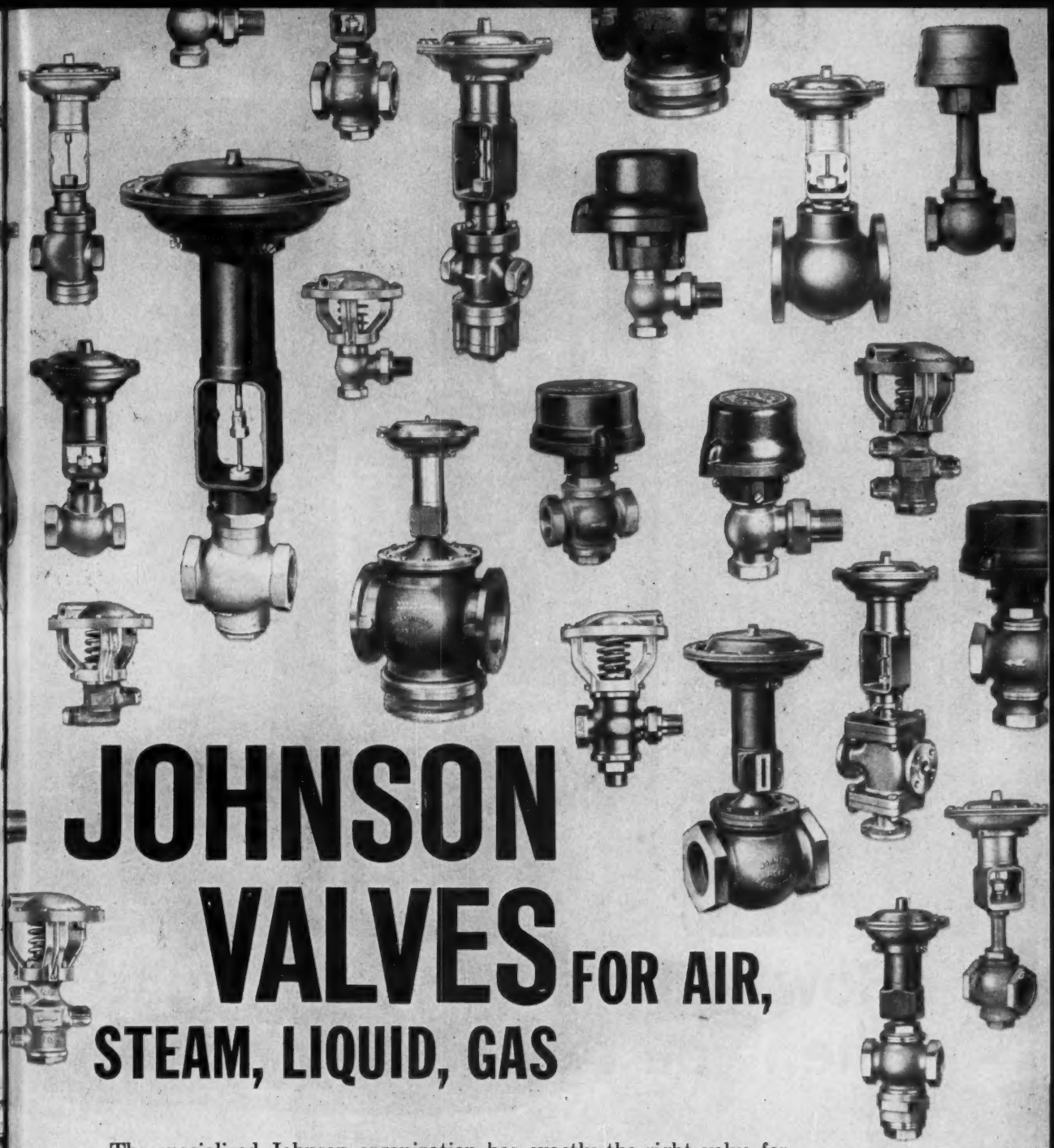
**MIXING VALVES**
— for applications requiring the mixture of liquids at different temperatures under control of a thermostat or humidostat. "Sylphon" and rubber diaphragm operators. Removable tops. Available in ½" to 10" sizes. Body patterns and operating features for every application.

**BY-PASS VALVES**
— for control of liquids over a wide range of temperatures and pressures. Sizes ½" to 6". Models available with 100% tight shutoff. Removable operators.

**WATER VALVES**
— especially designed for use with small room air conditioning and heating units. High grade bronze bodies. Rubber diaphragm operators. Corrosion resistant throughout. V-ring self-sealing packing assures positive seal. Renewable composition discs. Sizes ½" and ¾".

**STEAM VALVES**
— for control of low pressure steam. Rubber diaphragm or seamless "Sylphon" operators. Renewable composition discs especially compounded for steam service. Sizes ½" to 10". Choice of body patterns and features.

**BRINE VALVES**
— for control at pressures up to 50 psi. Cast iron or bronze bodies. Rubber diaphragm or "Sylphon" operators. Renewable discs, especially compounded for brine service. Removable tops. Sizes ½" to 8" in a variety of body patterns.



# JOHNSON VALVES FOR AIR, STEAM, LIQUID, GAS

The specialized Johnson organization has exactly the right valve for every possible air-conditioning, heating, or ventilating control system application. In fact, Johnson makes the most complete line of pneumatic equipment in the industry — for solving any problem of temperature, humidity, or pressure control.

**JOHNSON CONTROL**

PNEUMATIC SYSTEMS

DESIGN • MANUFACTURE • INSTALLATION • SINCE 1885

**JOHNSON SERVICE COMPANY**
507 East Michigan St., Milwaukee 1, Wisconsin

☐ Have a Johnson engineer call on me.

☐ Send your new condensed catalog of all types of Johnson Pneumatic Control equipment.

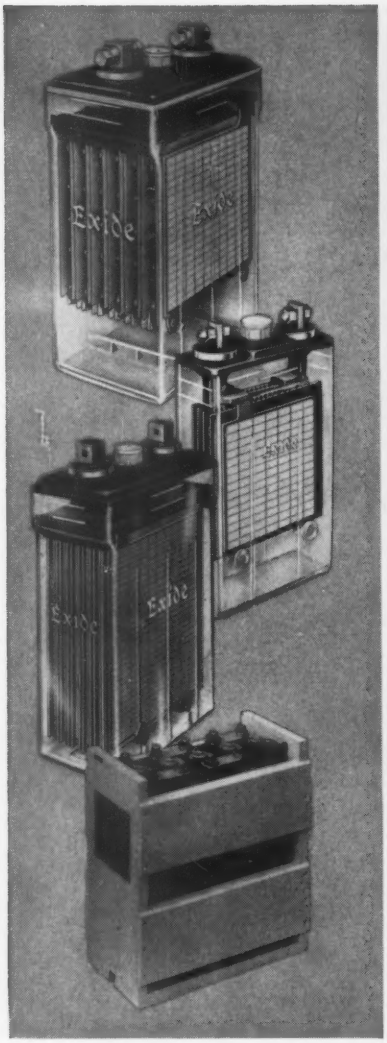
Name_____

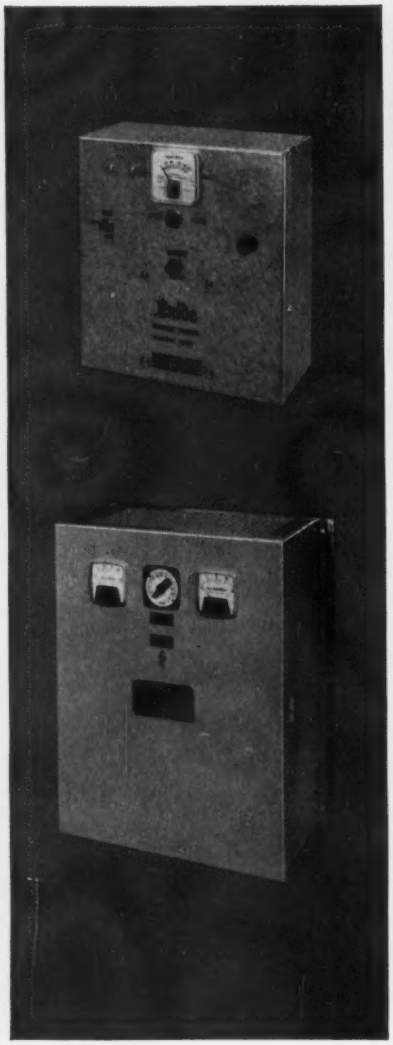
Title_____

Firm_____

Address_____

City_____ State_____



# How to be sure you're right when you buy battery power

**First.** Make sure your battery is selected on a basis of engineering information. This is how your Exide man makes his recommendation. Because the Exide line includes the broadest range of battery types, he is able to show you factually which particular type is best for you —flat plate Tytex with Silvium* or calcium, long life Exide-Manchex Planté type with Silvium, low maintenance pocket positive nickel-cadmium, or new 20-year Exide-Ironclad tubular with Silvium.

**Second.** Make sure your charger is engineered to meet the needs of your batteries. Exide chargers come in types and sizes to cover all charging requirements. Correct charging methods prolong battery life and reduce operating and maintenance costs. Choice of either constant voltage, trickle or Hi-Lo type chargers.

**Third.** Make sure you arrange for service provided by industrial battery specialists. It's included when you get an Exide power package. And it covers both your batteries and chargers. Over 200 Exide factory-trained field men coast to coast are ready to give you fast, competent service. Write for details on the complete Exide power package. Exide Industrial Marketing Division, The Electric Storage Battery Company, Phila. 20, Pa.

*Silvium is Exide's patented corrosion-resistant grid alloy

Exide®

INDUSTRIAL MARKETING DIVISION
The Electric Storage Battery Company

ESB



For more facts circle 226 on Reader Service card, p 121

circle 227 on Reader Service card, p 121 ➤

# BONUS LIFE

## BONUS PROTECTION

*from the Boiler Capital of the World*

THE TITUSVILLE WTP
FROM THE BOILER CAPITAL OF THE WORLD

• BONUS LIFE means longer life and less refractory maintenance made possible by Titusville's unique WTP design featuring *65% Black Surface Tube Area coverage on rear wall.*

Titusville's increased black surface tube area means less refractory maintenance through longer refractory life (less down-time for replacement) and a faster steamer.

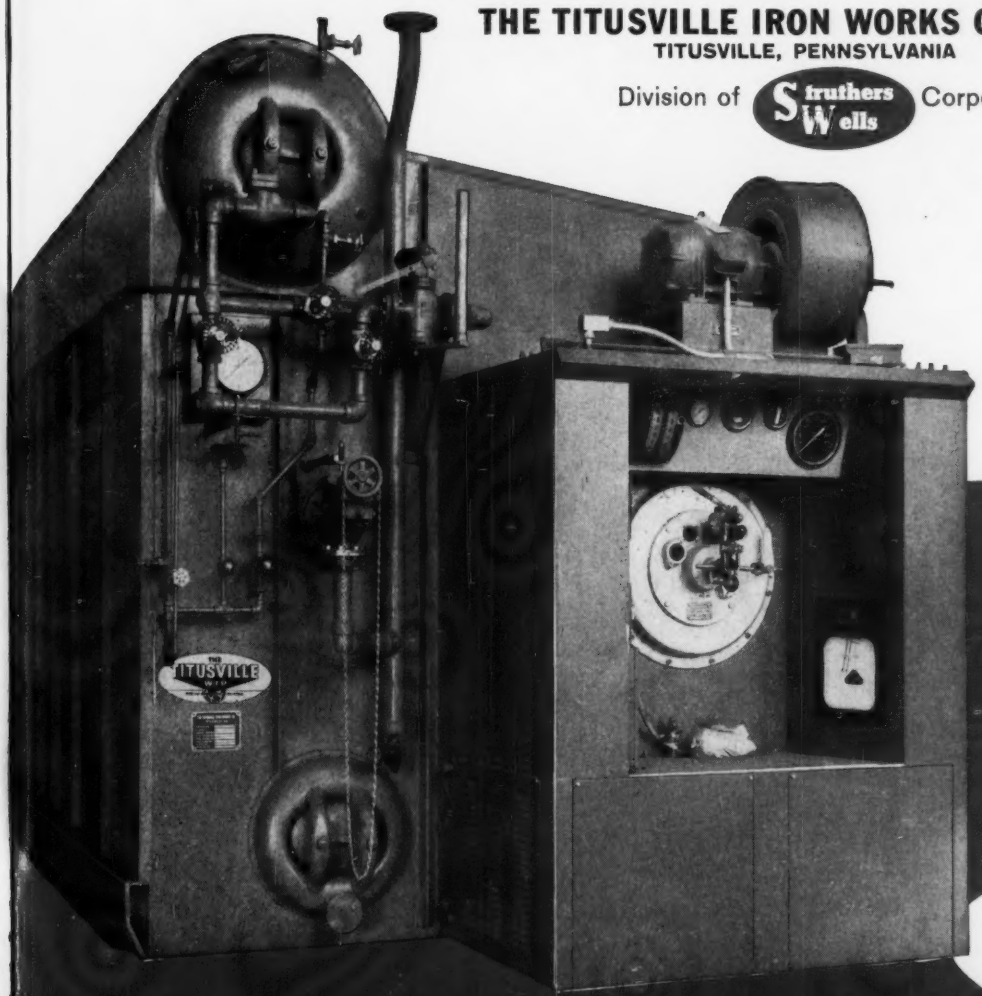
• BONUS PROTECTION provided by Titusville WTP's *double casing design* solves the corrosive product problem.

Most water tube steam generators operate intermittently. When dew point is approached at low fire condition, corrosive product can form quickly in single casing boilers.

Titusville WTP's double casing design (with insulation between) reduces temperature differential. Result: formation of corrosive product almost entirely eliminated for many times more casing life.

**THE TITUSVILLE IRON WORKS COMPANY**
TITUSVILLE, PENNSYLVANIA

Division of Struthers Wells Corporation

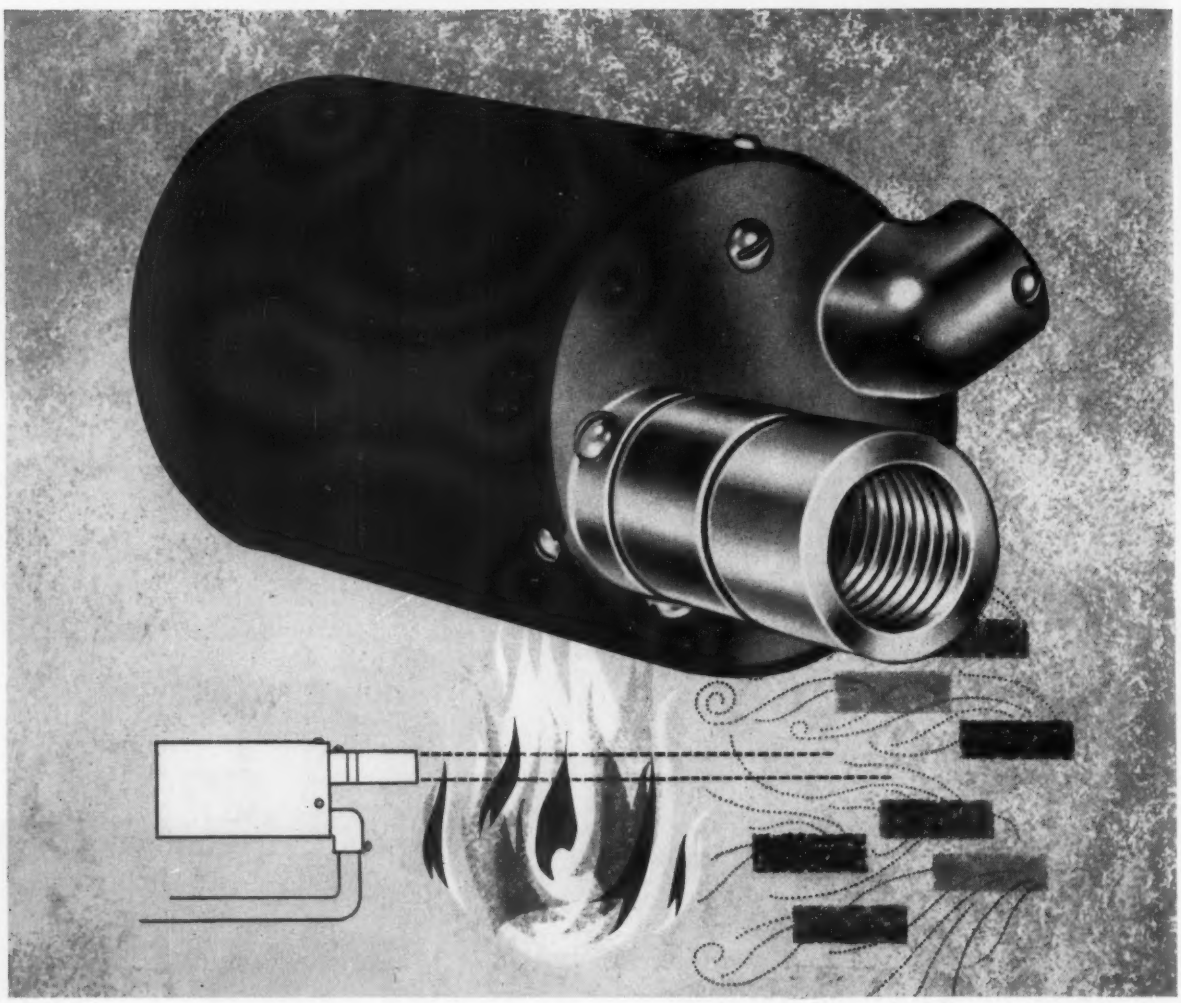



**Specify Titusville WTP ... the industry's fastest selling boiler**

*Selected exclusive sales territories available*

**Undetected flame failure can cause costly interruptions, do serious damage to expensive equipment and endanger lives. To prevent such loss, Honeywell has developed an ultraviolet flame detector that won't be fooled, because it positively differentiates between flame and hot brick.**

# This flame detector



Now, for the first time, you can be absolutely sure that fuel delivery will be stopped in the absence of flame. Honeywell's new C7012A Ultra-Vision* Flame Detector employs an amplified ultraviolet signal to positively distinguish between an actual flame (ultraviolet rays) and a hot refractory (infrared rays). This revolutionary new ultraviolet sensor represents a major breakthrough in scientific flame detection.

Because this compact new control device is not sensitive to a hot refractory, flame supervision of both single and multiple burners is simplified. The Ultra-Vision Flame Detector can be aimed at each individual flame in the most convenient way. It is the only device on the market that offers you this advantage.

Best of all, this new flame detector saves you money. Wiring is less expensive in this system than in a lead sulphide cell. It is easier to install because hot refractory can be ignored. And there is no further need for flame rod replacement.

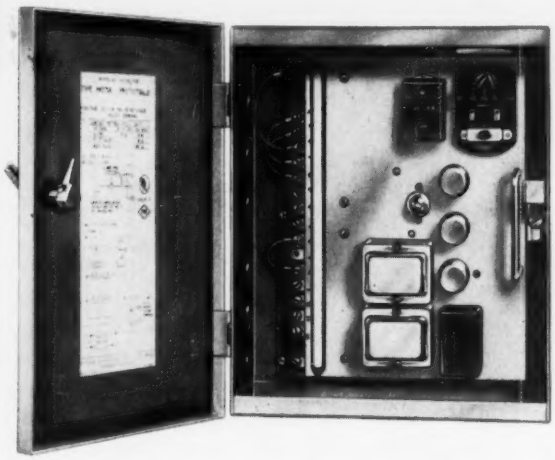
# senses only the flame!

## New Honeywell Protectoglo relay assures "maximum safety"

Available for use with the Ultra-Vision Flame Detector or with standard flame rods is Honeywell's famous R4075 Protectoglo* relay.

This new relay features "maximum-safety" self-checking which is particularly desirable for continuously burning industrial burners. A self-checking circuit checks the circuit and the components of the Protectoglo *once every second.*

The mounting cabinet of the Protectoglo has all-voltage terminals and a quick-disconnect control base that enables you to remove the relay without disconnecting any of the wiring. Plug-in components can easily be removed and replaced if necessary.



In addition, flame-rod assemblies are available to meet every industrial application. Alarm contacts can be powered from separate line or low-voltage circuit. And a special zinc dichromate finish resists the corrosive effects of most industrial atmospheres.

*Trademark

## Honeywell protects Los Angeles' new $65,000,000 power plant

Los Angeles' Department of Power and Water installed the Honeywell Ultra-Vision Flame Detector and Protectoglo System to insure maximum flame safeguard protection for its new Scattergood Steam Plant. This huge power facility covers a 57-acre ocean front site south of the Playa del Rey district of Los Angeles.

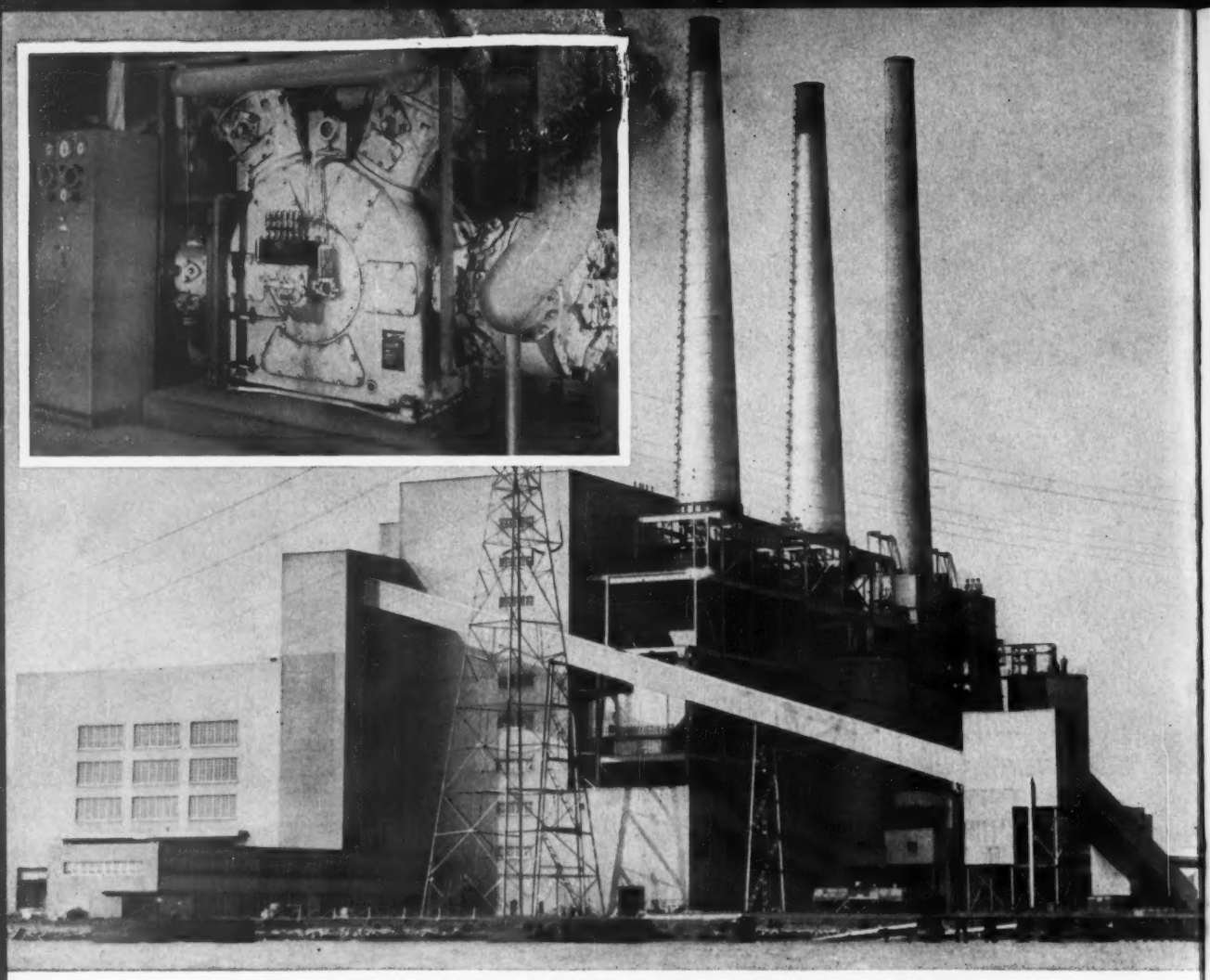
The plant now uses two 91-foot-long turbine generators to produce 320,000 kilowatts of power. When the entire complement of six generators is put into operation, the anticipated output will be 1,200,000 kilowatts.

Gas, oil or a combination of both fire the Scattergood boilers. Gas consumption under full load is approximately 1,520,000 cubic feet per hour, and oil is used at 250 barrels an hour. Boilers are 133 feet high and furnace volume is 65,000 cubic feet.

For full information about Honeywell Flame Safeguard Control Systems, call your nearby Honeywell office. Or write Honeywell, Dept. PR-6-23, Minneapolis 8, Minnesota. In Canada, write Honeywell Controls, Limited, Toronto 17, Ontario.

**Honeywell**

H HONEYWELL First in Control SINCE 1885



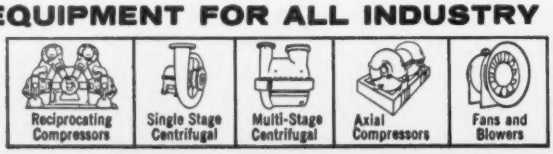
# MODERN JOY WH-234 COMPRESSOR SUPPLIES 300 LB. SOOT BLOWING AIR AT DETROIT EDISON'S RIVER ROUGE PLANT

A Joy WH-234 Semi-radial Compressor was installed at the River Rouge Plant to provide additional 300 pound soot blowing air when a huge 321,500 KW turbine-generator was added in 1957. The new unit gave the River Rouge Plant a total installed capacity of 841,500 KW, making it one of the largest power plants in the country.

Joy's modern semi-radial construction provides a compressor which is both rugged and compact. Floor space requirements are less than for any other type of compressor of comparable capacity, yet valves are easily accessible for inspection and maintenance. Truncated piston design gives high compressor efficiency by reducing head clearance to a minimum—cutting re-expansion loss. Like all Joy compressors, the WH-234 features replaceable cylinder liners and crosshead guides, force-feed lubrication and rugged construction throughout for long, maintenance-free service life.

Consult your Joy representative for complete details on Joy high pressure compressors for soot blowing, or write for Bulletin 2554-16. 2554

**AIR MOVING EQUIPMENT FOR ALL INDUSTRY**

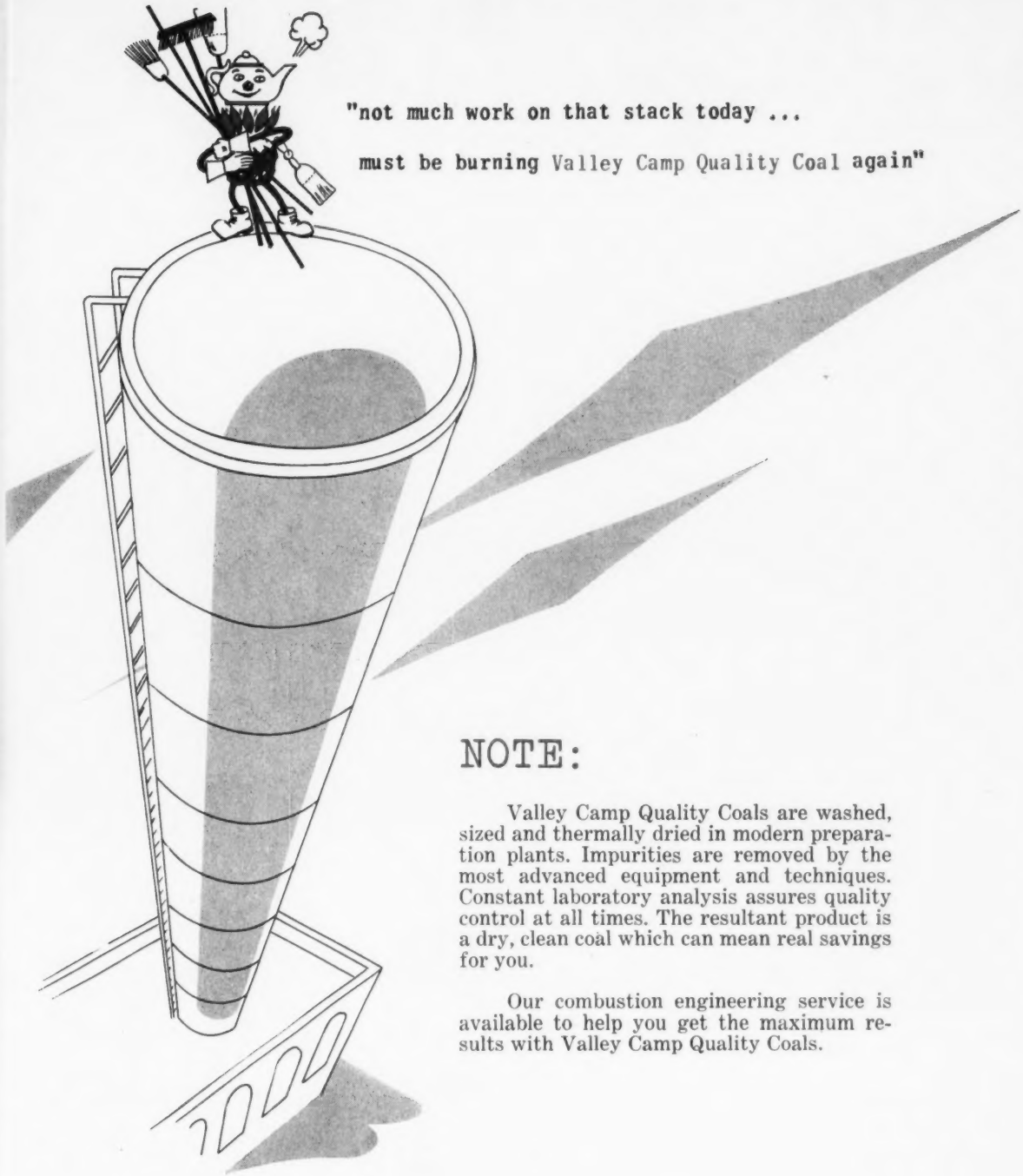



**JOY**

**Joy Manufacturing Company**
**Oliver Building, Pittsburgh 22, Pa.**

In Canada: Joy Manufacturing Company (Canada) Limited, Galt, Ontario

For more facts circle 229 on Reader Service card, p 121




## NOTE:

Valley Camp Quality Coals are washed, sized and thermally dried in modern preparation plants. Impurities are removed by the most advanced equipment and techniques. Constant laboratory analysis assures quality control at all times. The resultant product is a dry, clean coal which can mean real savings for you.

Our combustion engineering service is available to help you get the maximum results with Valley Camp Quality Coals.

# THE VALLEY CAMP COAL COMPANY

**Western Reserve Building • Cleveland 13, Ohio**

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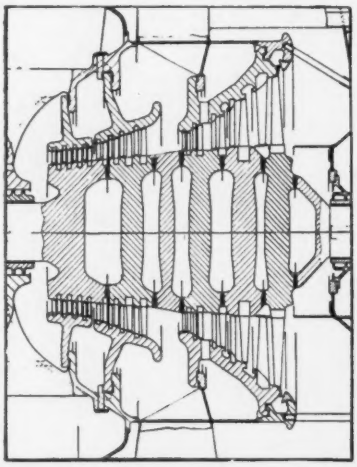
# Welded sectional rotors for steam turbines

BROWN BOVERI

*By N. K. Halsteen, Project Engineer, Brown Boveri Corp.*

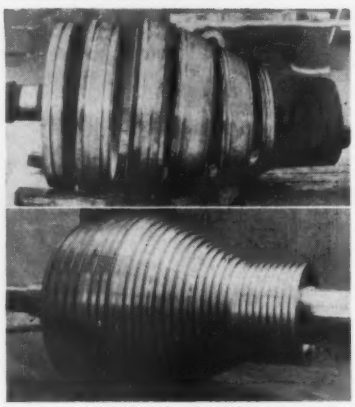
*The manufacture of large, solid, one-piece rotors presents problems in detection and inspection of flaws, often resulting in the difficult choice of scrapping an expensive forging or completing the rotor with a "patch" or with an internal flaw whose effect in operation cannot be predicted with certainty. In use, the mass of a solid rotor also causes difficulty in maintaining tight shrink fits for the wheels and prevents uniform heat distribution for short start-up or shut-down schedules.*

*To avoid these difficulties, Brown Boveri developed a rotor made of forged discs and hollow, bell-shaped end sections welded together at the rims, forming a light, strong, rigid unit.*



Cross-section of low-pressure stage showing welded segments of rotor shaft.

## How Brown Boveri sectional rotors are made



Above: Sections of shaft ready for welding.

Below: The shaft after welding, heat-treatment and machining.

The rotor is assembled vertically on a turntable, the sections being centered by spigots. As the workpiece rotates past welding heads, the butting surfaces are welded. Welds are made at several points around the section at the same time—to prevent distortion. The welding is done automatically by the tungsten inert-gas process . . . providing homogeneous welds free of slag.

After a few layers of weld, the root is checked with gamma rays. If approved, the welding is completed.

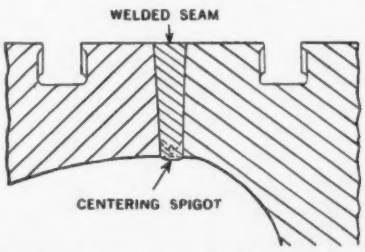
After a final ultrasonic test, the welded area is given stress-relief heat treatment, with the rotor in vertical position. Machined rotors are tested at 40% overspeed before blading . . . also balanced statically and dynamically after blading.

## Advantages of sectional rotors

Because of the relatively small size of each section, forging conditions meet ideal metallurgical requirements. Inspection can be complete. Doubtful sections are scrapped without any attempt at "patching." Possible asymmetries resulting from forging are cancelled by the chance disposition of individual sections.

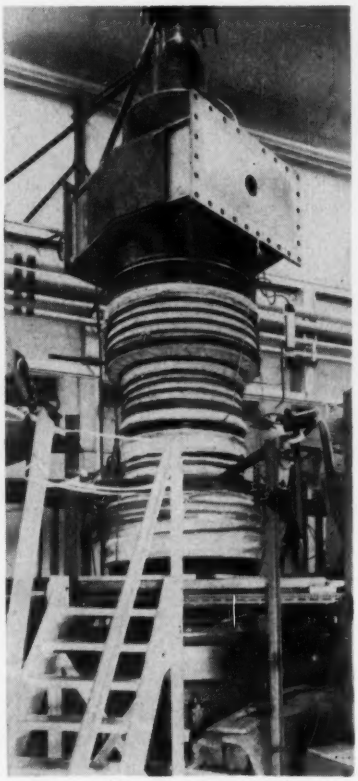
The stress-relieving procedure practically eliminates asymmetrical stresses.

The low mass of the rotor results in a favorable mass ratio between rotor and casing . . . with far less critical expansion differentials during sudden load changes or short start-up and shut-down schedules.




Cross-section of weld seam. Note uniform thickness of rims at weld — for minimum thermal stresses.

As evidence of its sound engineering, the Brown Boveri sectional rotor design has been used for over 30 years in several thousand rotors—and without a single explosion or other serious rotor failure.



Automatic welding of sections. Also shown are insulating blanket and induction heating cable for pre-heating before welding and stress-relief treatment after welding.

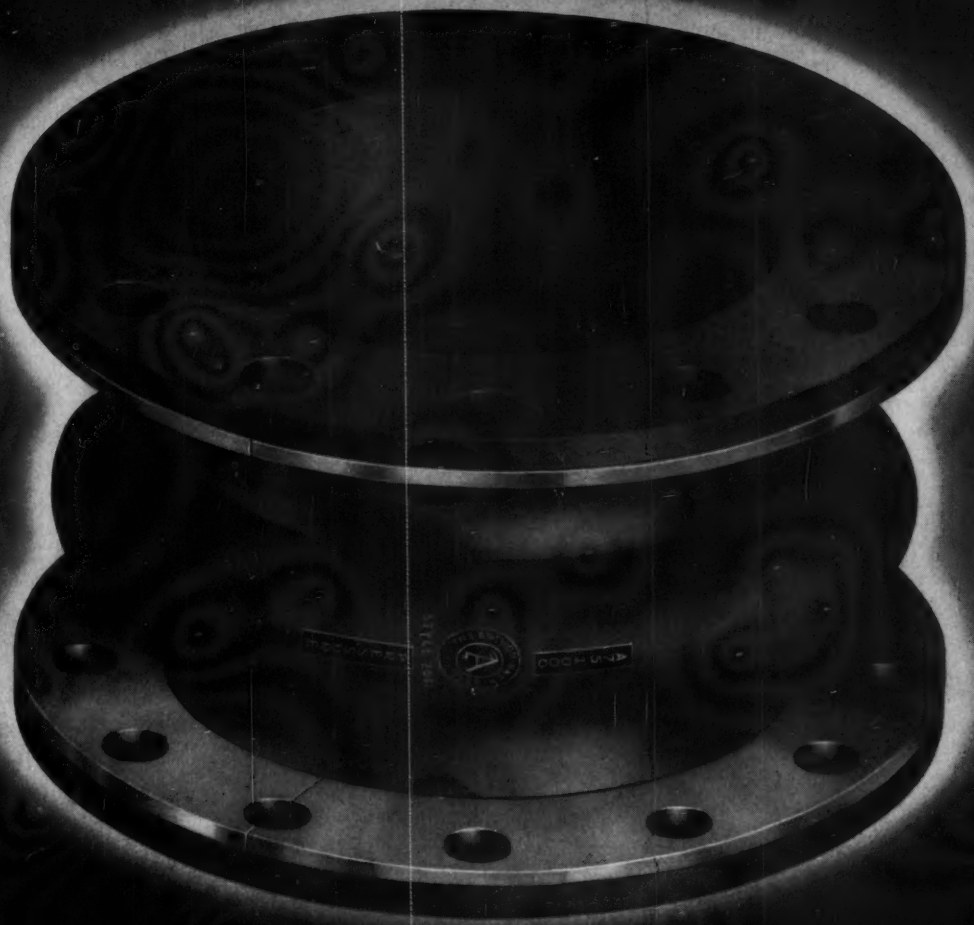
Other features of Brown Boveri steam turbines: an all-hydraulic governing system without rods, levers or mechanical joints subject to wear and resulting inaccuracies . . . and an unequalled reliability of service illustrated by many Brown Boveri turbines built 40 to 45 years ago and still in continuous operation.

**BROWN BOVERI** Brown Boveri Corp., Dept. P6, 19 Rector Street, New York 6, N.Y. Agents in 27 U.S. cities



For more facts circle 231 on Reader Service card, p 121

circle 242 on Reader Service card for following ad ➤



# ANKORITE RUBBER EXPANSION JOINTS

## *eliminate*

## VIBRATION • EXPANSION • CONTRACTION

Ankorite Expansion Joints will solve your problems of vibration, expansion and contraction. Reinforced expansion joints are available from rubber, Hypalon, Viton, other synthetics, and Anklon (duPont's Teflon) selected for greatest suitability for use on air, gas, water, chemical lines and many other applications.

Check this list of plus features . . .

Absorbs Transfer of Sound • Absorbs Vibration • Axial & Lateral Movement • Corrosion Free • Ease of Installation • Embrittlement Free • Erosion Resistant • High Working Pressure • Lightweight • Long Lasting • Low Force Required to Move • No Electrolysis • No Flex Cracking • No Gasket Required • Small Permanent Set • Shock Absorbent • Small Space Required

Furnished in special shapes with flanges . . . sleeve type . . . tapered . . . lightweight . . . offset . . . or non parallel flanges, etc.

For further information write today.

*Product of the E. I. duPont Co.

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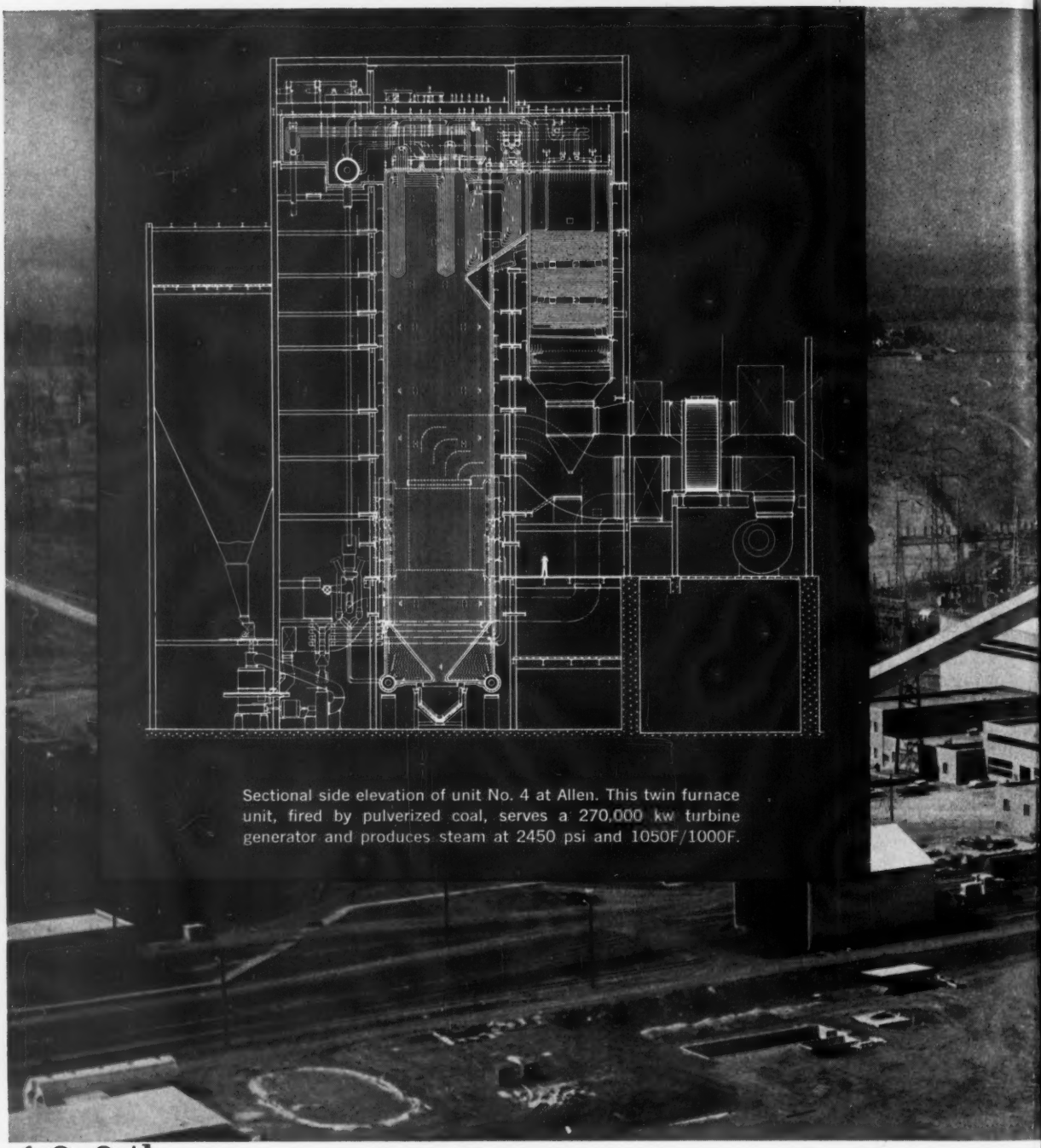

Sectional side elevation of unit No. 4 at Allen. This twin furnace unit, fired by pulverized coal, serves a 270,000 kw turbine generator and produces steam at 2450 psi and 1050F/1000F.

# 100th C-E CONTROLLED CIRCULATION

**Late in 1960, C-E's one hundredth Controlled Circulation Steam Generator was placed in operation. Located at Duke Power Company's Allen Plant, this, the fourth Controlled Circulation unit in service at Allen, will soon be joined by a fifth, now under construction. The Duke Power system presently has more than 2,300 mw of Controlled Circulation generating capacity, installed or on order.**

**Since the first postwar C-E Controlled Circulation unit was placed in service about eight years ago, this type of unit has established itself as the design best suited for the 2400 lb throttle pressure**

ALL TYPES OF STEAM GENERATING, FUEL BURNING AND RELATED EQUIPMENT; NUCLEAR REACTORS;

# UNIT NOW IN SERVICE

range, and has achieved unparalleled acceptance throughout the utility industry. Today, units of this design are on order, under construction, or installed in utility plants the world over. The total capacity of the turbine generators served is about 30,000 mw.

**COMBUSTION ENGINEERING** C-E

C-314

General offices: Windsor, Connecticut
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PAPER MILL EQUIPMENT; PULVERIZERS; FLASH DRYING SYSTEMS; PRESSURE VESSELS; SOIL PIPE

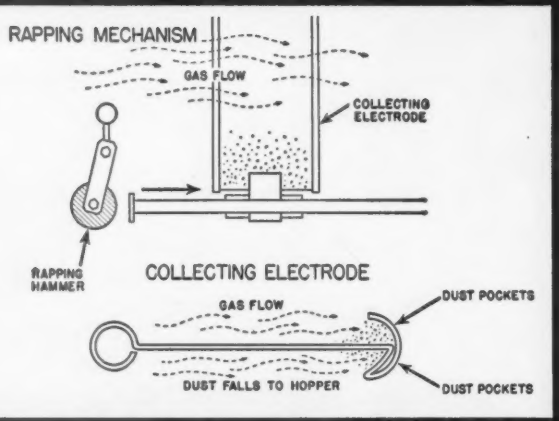


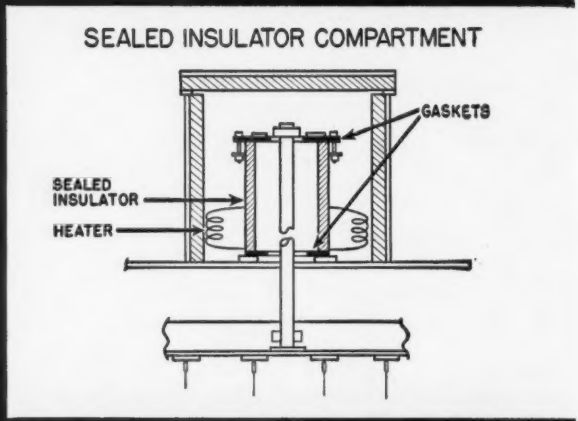
For more facts circle 233 on Reader Service card, p 121

# SOME PLAIN FACTS

## ABOUT SUPERIOR PRECIPITATOR PERFORMANCE

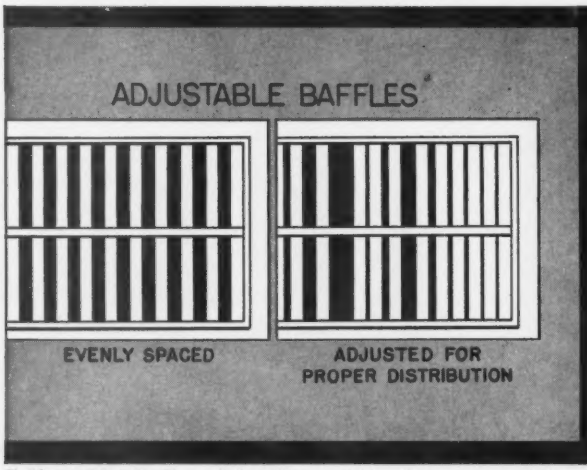
**Buell Precipitators are designed and constructed for rugged service and superior performance. Frills and internal frim-fram of a doubtful value are eliminated in favor of strength and simplicity. The casing, outside supports, and internal parts are of rugged construction; and the four-point suspension of emitting electrodes ensures the greatest stability. Here are just a few of the outstanding features of Buell Precipitators.**




**Effective Continuous Cycle Rapping**—Yes, it's mechanical. A simple, rugged system free of complicated gadgets; assures positive dust shearing action. Each row of electrodes is rapped separately—in the direction of the gas flow—on a continuous cycle. Dust is sheared off, drops in an agglomerated mass and pockets on electrodes minimize reentrainment.

**Sealed Insulators Improves Operation**—High voltage quartz support insulators are completely sealed; prevents gas and dust leaking into insulator compartment and outside air leaking into precipitator. There is no need for costly ventilating systems. Thermostatically controlled electric heaters insure start-up without danger of moisture condensation and insulator breakdown.



**Uniform Distribution of Gas Flow**—Field adjustment capability is vital. Buell's adjustable baffle permits final positioning after field measurement of actual flow distribution . . . because gas flow patterns are not entirely predictable. The Buell distribution system assures equal gas loading through the precipitator; eliminates ineffective "dead" areas around passages and prevents "sneak-by."

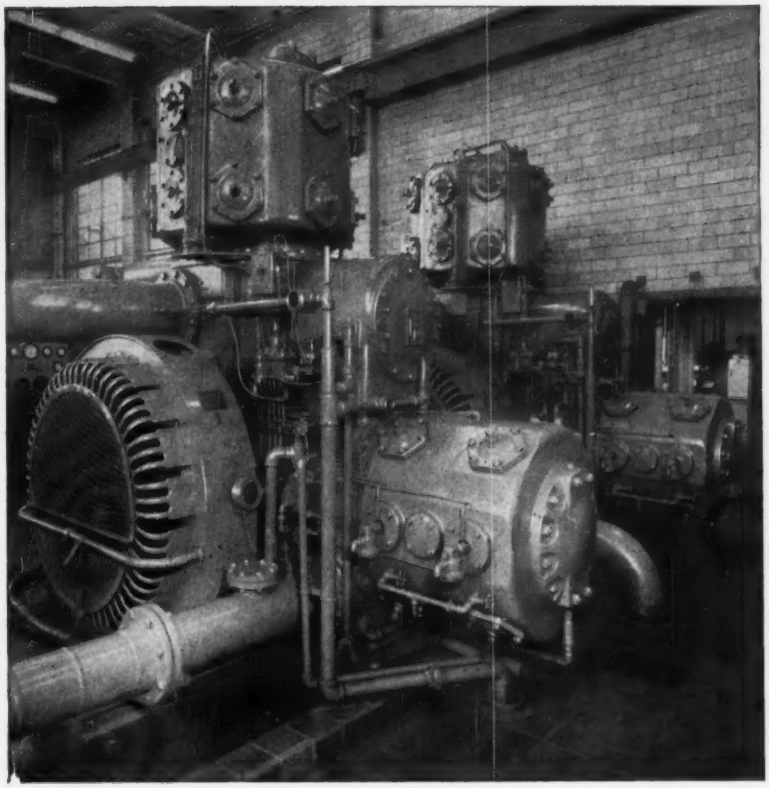
**Buell Spiralectrodes cut maintenance to a minimum.** Buell's record stands at less than 1% replacement in this key area. Self-tensioned spiralectrodes eliminate vibration and "off-center" swaying, often prevalent with weight-tensioned wires. They're structurally fixed and once installed stay in alignment. The spiralectrode provides greater emission than straight wires.

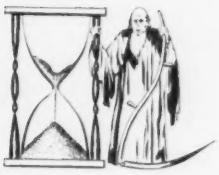
**Buell precipitators are simple and effective. They're designed for continuous service. You'll be glad you turned to Buell when you experience superior performance and low maintenance. Detailed literature describing all features is available.**

buell Norblo

**The Buell Engineering Co., Inc., Dept. 50-F, 123 William Street, New York 38, N. Y. Northern Blower Division, 6428 Barberton Avenue., Cleveland, Ohio.**
**■Electric Precipitators ■Cyclones ■Bag Collectors ■Combination Systems ■Fans ■Classifiers.**


For more facts circle 234 on Reader Service card, p 121





IN I-R COMPRESSORS,

**TIME** TELLS

THE DIFFERENCE

In these two XLE compressors, 21 Channel Valves have operated

# 45,482 HOURS

## with no parts replaced!

The two Ingersoll-Rand XLE air compressors shown above are installed at a large midwestern automotive plant. They were started up in May, 1951, and at this writing have totalled 45,482 hours, mostly at 16 to 24 hours a day.

Of the 28 Channel Valves (14 per unit), 21 have operated full time with *no repairs,* merely being cleaned once a year. Each of the other seven valves had only one channel and spring replaced in all this time, during the scheduled inspection period. And all the valves are operating with their seat plates still on the first side – when the plates are turned over, their life will be doubled.*

The *extra value* that's built into every type of Ingersoll-Rand compressor pays off with *long-run economy.* Reduced maintenance and attention, over many years, mean long-range savings in the cost of air power. Ask your I-R representative for more information on the world's most complete line of compressors, from 1/2 to 7500 hp. Call him now.

***Only I-R compressors have Channel Valves**

Known for high efficiency, quiet operation and exceptional durability. Entirely different. Each valve is a combination of rigid stainless-steel channels and bowed leaf springs, with trapped-air spaces which cushion action, prevent impact.

Ingersoll-Rand

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The World's Most Comprehensive Compressor Experience



For more facts circle 235 on Reader Service card, p 121

*producing URANIUM in SASKATCHEWAN*
*or NITRATES in CHILE . . .*

# NORDBERG ENGINES

## continually prove their reliability and economy

Neither bitter cold, nor inaccessible location could stop the successful development of a strategically valuable uranium ore deposit by Gunnar Mines, Limited, located in northwest Saskatchewan, less than 450 miles south of the Arctic Circle.

To meet their electrical power requirements, Gunnar chose seven Nordberg Supairthermal® 4-cycle diesel engine-generator units, each rated 1200 hp at 450 rpm, direct connected to 845 kw generators. Adding to the efficiency of this installation are waste heat boilers which utilize exhaust gas from the Nordberg engines to produce steam for heating plant buildings.

* * *

The story of power plant expansion for Anglo-Lautaro Nitrate Corporation's vast operations in northern Chile is largely a story of reliable Nordberg power. Their original Nordberg engine was a 7100 hp diesel unit installed in the Pedro de Valdivia plant, followed by the installation of two 1900 hp Nordberg diesels for the plant at Maria Elena. Then, to meet much needed additional power, two big 9600 hp Nordberg diesels were installed in a new power plant at Coya Sur.

Anglo-Lautaro has again turned to Nordberg to meet further power expansion, and is installing *five more* Nordberg diesels, each rated 5750 hp, in the Pedro de Valdivia power plant. The combined capacity of all ten Nordberg engines will provide over 38,000 kilowatts for nitrate production.

* * *

*While these particular power assignments are widely separated geographically, they are striking examples of the way in which Nordberg engines produce power for the world's major industries . . . many of which are in remote, inaccessible areas where dependable operation is of prime importance.*

**NORDBERG MANUFACTURING COMPANY**
**Milwaukee 1, Wisconsin**

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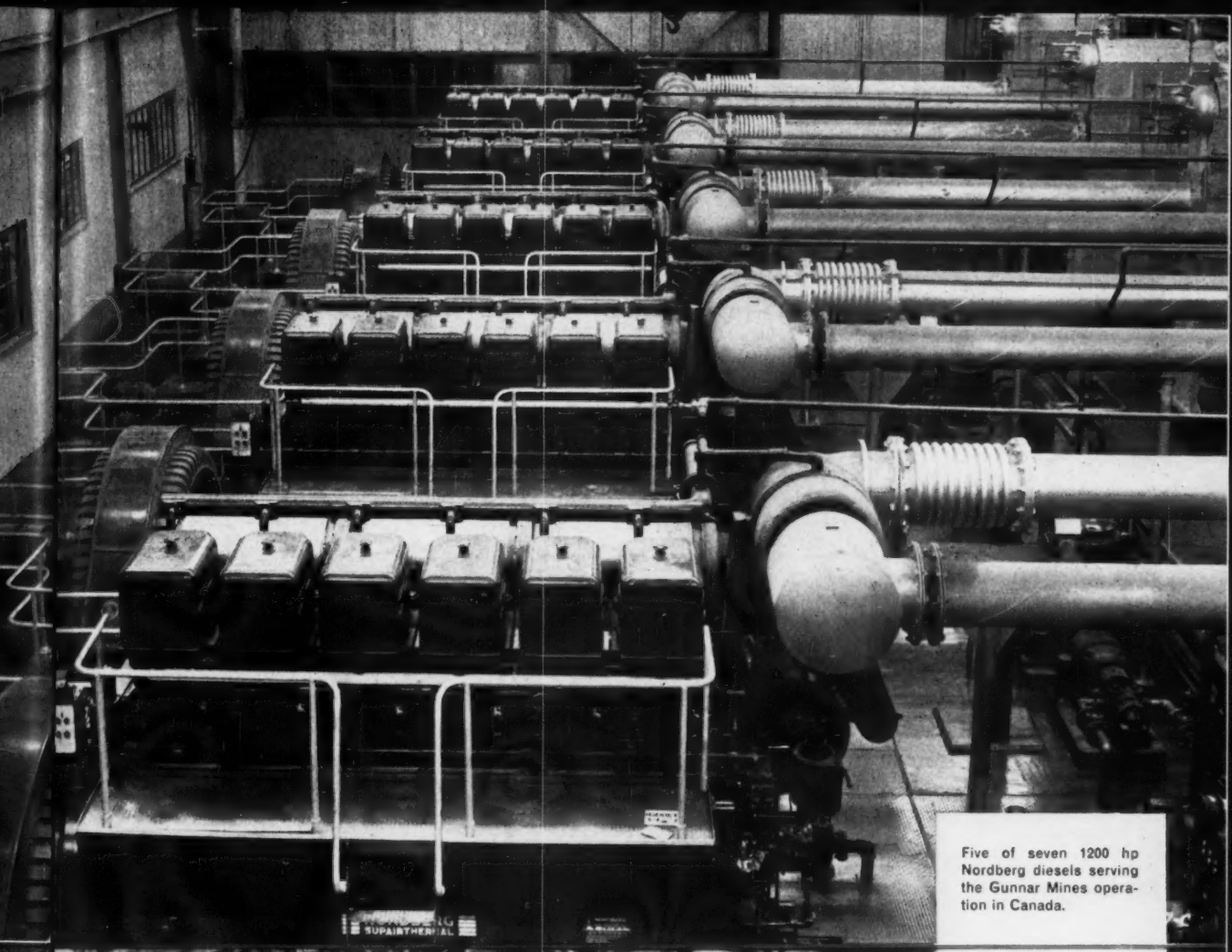
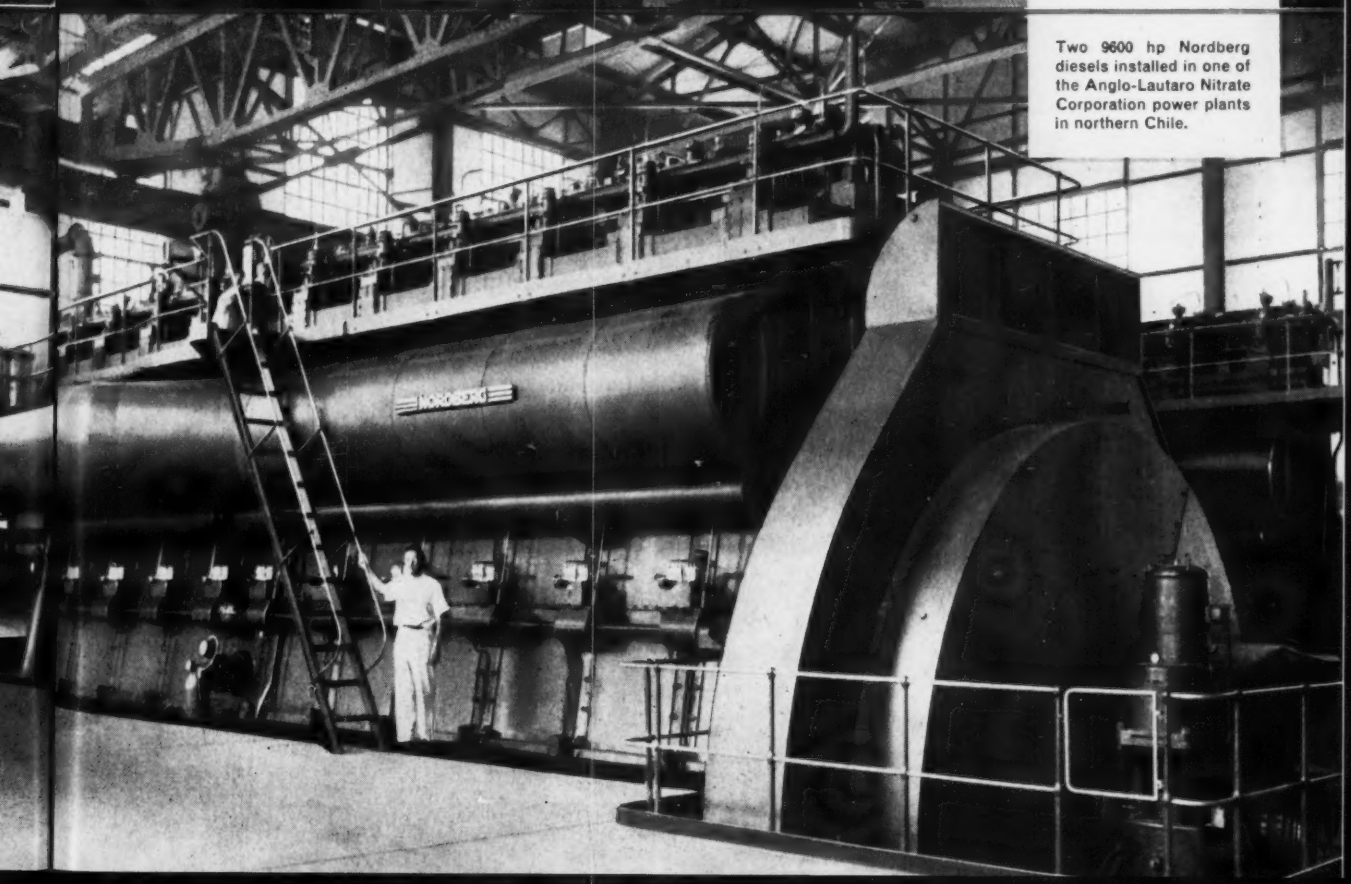
**For more facts circle 236 on Reader Service card, p 121**

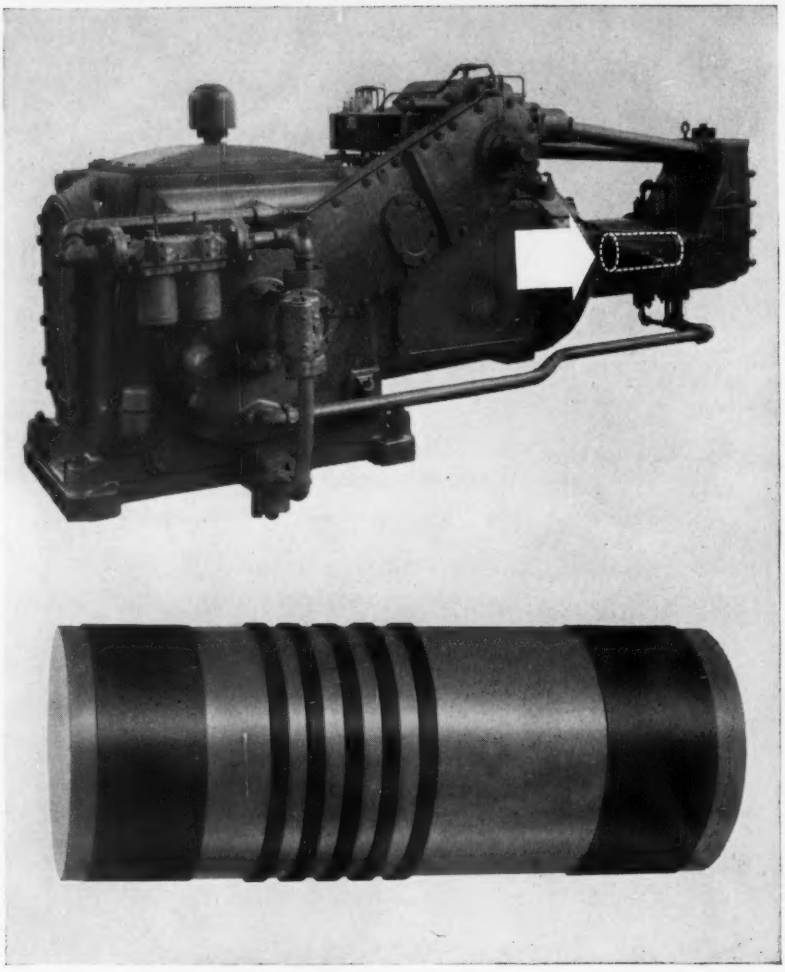


Five of seven 1200 hp Nordberg diesels serving the Gunnar Mines operation in Canada.



Two 9600 hp Nordberg diesels installed in one of the Anglo-Lautaro Nitrate Corporation power plants in northern Chile.

**Cooper-Bessemer applies** Garlock Teflon* Piston and Rider Rings (bottom, to prevent leakage and assure proper piston support) on the Type FXA expander engine (top). In a special closed-loop test, the engine is evaluated over a wide range of conditions in the process of air liquefaction.



# NEW ENGINEERED TEFLON PISTON RINGS for Non-Lubricated Service

**Cooper-Bessemer chooses Garlock Teflon Piston and Rider Rings for severe duty on their new FXA expander engine.** Against pounding 2000 p.s.i. pressures, and at temperatures that dip to an icy −270°F, the Teflon rings seal tight without lubrication on the power piston of an expander engine that provides various gases at cyrogenic temperatures, while harnessing power at the same time.

**Cooper-Bessemer is optimistic about the new** Garlock Teflon Piston and Rider Rings. Since inception of the Type FXA gaseous expander engine, the rings have performed with negligible wear, and have eliminated the most undesirable hazard in an oxygen plant—contamination of the gas either from lubrication or from the ring materials themselves. Teflon Piston and Rider Rings need absolutely no lubrication and are unaffected by—and do not affect—gases, chemicals, and most other process materials.

**The first really satisfactory rings** for non-lubricated service, Garlock Teflon Piston and Rider Rings will not crack or break, will not score cylinder walls, and are flexible for easy installation . . . withstand temperatures from −420°F to +500°F; available in carbon-filled or glass-filled Teflon in either butt joint, step joint, scarf cut or solid.

**On this application,** Cooper-Bessemer also applies rod packing rings and scraper rings—more of the complete line of high-quality Garlock metal packings. If you have a sealing problem, ask your Garlock representative for assistance. Call him at the nearest of the 26 sales offices and warehouses throughout the U.S. and Canada. Or, write for Catalog AD-178. Garlock Inc., Palmyra, N. Y.

**Canadian Div.:** Garlock of Canada Ltd. **Plastics Div.:** United States Gasket Company. **Order from the complete line** of quality Garlock products . . . Packings, Gaskets, Seals, Molded and Extruded Rubber, Plastic Shapes and Parts.

*Du Pont Trademark

# GARLOCK

# TURBINES:

## Shell reveals three ways that Turbo Oils help prevent oil breakdown, rust, sludge and foaming

**Small quantities of air and water can work their way into any turbine lubrication system. These contaminants can accelerate oxidation of the oil.**

**Read how Shell scientists developed a specific formulation that counters this oxidation and brings you turbine lubricating oils with top performance records.**

WHEN oxygen attacks turbine oil, it can form peroxides and organic acids. A chain of oxidation reactions begins. If the oil stability is inadequate, sludge can form.

Air entrained in the oil can aggravate oxidation. And it may cause foaming.

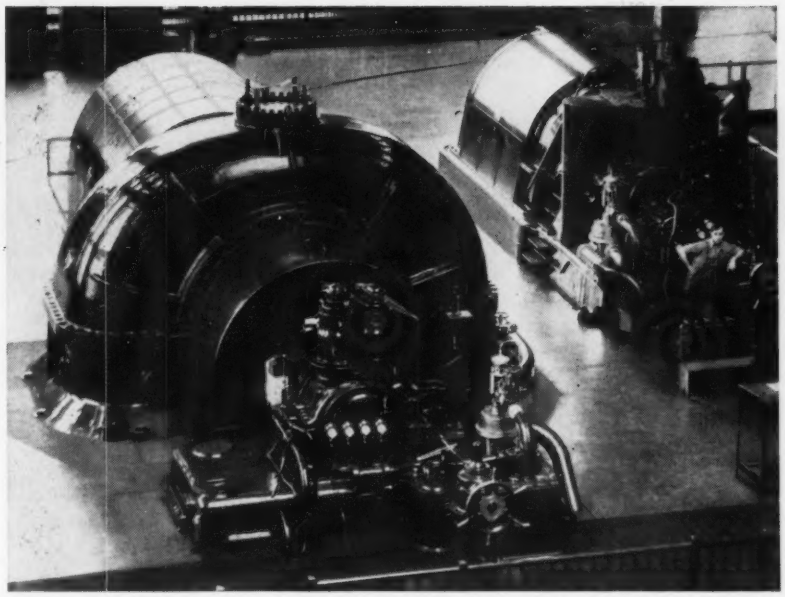
The oil may also be affected by water in the system. Laboratory tests have shown that water can greatly accelerate an oxidation process.

With Shell Turbo® Oil, Shell tackles these problems in three key ways:

**1.** *Shell carefully selects base oils for use as turbine lubricants,* then refines them to get the most effective response to Shell's special additives.

**2.** *Shell adds a powerful oxidation inhibitor to its precisely refined base oils.* This inhibitor helps prevent the chain of oxidation reactions caused by oxygen exposure at operating temperatures. It helps keep the oil in good condition, and lengthens its service life.

The result is that Shell Turbo Oils have proved themselves unusually stable over long service periods.



**Shell Turbo Oils** lubricate turbines with total rating of more than 17 million kw in the U. S. and Canada.

**3.** *Shell uses an outstanding rust inhibitor.* As a protective measure, Shell uses special additives that cover metallic surfaces with strongly adherent polar-type films.

These films are specially designed to help keep water from the metal surface.

*In drastically accelerated laboratory tests, metals immersed in Shell Turbo Oils show outstanding anti-rust performance—even in the presence of sea water.*

Ask your Shell Industrial Products Representative for facts on Shell Turbo Oils. Or write: Shell Oil Company, 50 West 50th Street, New York 20, New York.

**Memo to utilities**

Ten turbines in the U. S. have been running on Shell Turbo Oil 27 *since 1938.*

In Canada, Shell Turbo Oils lubricate turbines generating more than half of all steam power produced.

SHELL

**A BULLETIN FROM SHELL**
**—where 1,997 scientists are working to provide better products for industry**

For more facts circle 238 on Reader Service card, p 121

Circle 239 on Reader Service card for following ad ➤

# The Story of Edward Research

# and the "Perfect" Globe Valve

Edward designers built the Figure 848 forged steel globe valve from scratch. In an art where most development effort must be directed toward modification, adaptation, and refinement of existing technology, the 848 story is almost unique. The objective was simple: To design and construct a perfect 600-lb-class globe valve in the ¼" to 1" size range. (Basic rating 600 lb at 910 F, 2000 lb WOG.) That the project was virtually successful is a tribute to the ingenuity of the Edward Research Staff and the equipment which enabled them to validate their progress. Here, is that story.

Three areas were given special consideration by the Edward staff of engineers and metallurgists when they set out to design a "perfect" valve. They were: 1. Body Shell and Bonnet Joint; 2. Seat Tightness; 3. Packing Area. Although each area was treated separately, the relationship of one to the other was a factor that had a great deal to do with the outcome of the project.

A series of "torture" tests such as the pressure pulsator shown on the opposite page carried each part and joint to the point of destruction. Thus Edward designers were able to trace each weakness to its source. Perhaps no other valve ever designed has been known and understood so well by the men who designed it.

**1. BODY SHELL AND BONNET JOINT.** The valve bonnet was bolted finger tight; it tested at 2000 psi. Then, at full design tightness on all four bolts, the bonnet joint did not leak until 11,000 psi (5½ times design pressure!) was applied. Next, 8000 psi applied 100 consecutive times produced no apparent valve damage. Internal pressure was pulsated from 200 to 2000 psi for 10,000,000 cycles with no apparent damage!

The bonnet cap screws were subjected to 350% of design tightness before failure occurred. Further evidence of design effectiveness was the unpredictability of failure. In one case the threads stripped; in another the bolts broke off, and in other there was excessive bending of the bonnet flange. There was no *one* apparent point of weakness!

**2. SEAT TIGHTNESS.** Similar destructive tests were conducted on the valve stem and seat. The valve required on 65% of standard test closing torque to seal tight at 2000 psi. And 350% of standard torque was built up before the stem sheared below the handwheel. 100 operations at 2½ times standard torque did only negligible damage to seating surfaces. Even after this test only 90% of standard test torque was needed to hold 2000 psi.

**3. PACKING AREA.** Six times as much load as actually required to seal the packing chamber was applied to the gland bolts without causing damage. A load 3½ times greater than required for sealing was applied 50 times, also without causing damage.

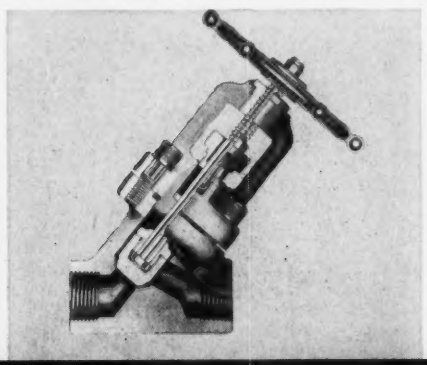
Thus the "perfect" globe valve was designed; perfect not because it can't fail, but perfect because it has no apparent weaknesses. The full design and construction story is told in Edward Catalog 14-G.

Edward builds a complete line of forged and cast steel valves from ¼" to 24" for industrial, marine, petroleum and technological services. For more detailed information, contact your Edward Representative, or write Edward Valves, Inc., 1230 West 145th Street, East Chicago, Indiana. Subsidiary of Rockwell Manufacturing Company. Represented in Canada by Lytle Engineering Specialties, Ltd., 438 St. Peter Street, Montreal.

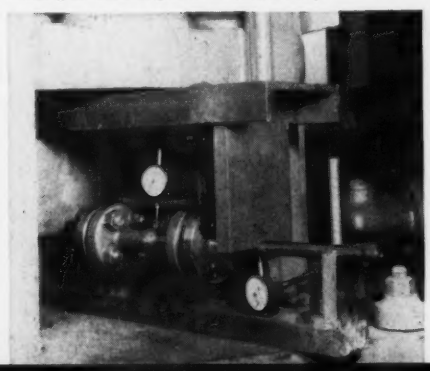
EDWARD STEEL VALVES
another fine product by
ROCKWELL

**Chief Engineer C.A. Siver and Design Engineer Don Easton observe effects of pulsating pressure on newly designed Figure 848 forged steel globe valve in Rockwell-Edward Research Lab.**

**Rugged forged steel body . . .** combined with high-strength stainless steel gland bolts and bonnet bolts, aluminum-bronze alloy yoke bushing, asbestos-stainless spiral gasket and other premium features . . . makes the Figure 848 a virtually "perfect" small steel valve.



**Test arrangement** produces uniform bending moment on valve and ½" pipe. Test shows that the strongest pipe likely to be attached to the valve will yield with less than ⅓ the bending moment required to distort body.



# SOLVE THESE NINE KEY WATER HANDLING PROBLEMS IN YOUR POWER PLANT WITH PEERLESS PUMPS

***apply these proven-in-use pumps to cover a broad range of services in circulating, boosting, draining and transfer applications...***

Producing power calls for equipment that can meet the rigors of continuous day-in, day-out performance. It calls for top performing pumps teamed with maximum engineering stamina.

It's a standard that Peerless meets and beats with ease. Small wonder then that Peerless equipment is selected in job after job. But Peerless offers you another added plus—careful, conscientious field engineering service. It's there when you want it, and it is there to help you in planning the best practical methods for handling the various pumping jobs you have. Here's another point to consider. The Peerless line is a complete one. Select your needs from pumps ranging from small fractional horsepower models to giant units capable of moving up to 220,000 gpm. Check the pumps listed below and request your copies of the bulletin you wish sent to you. Write Peerless Pump, Hydrodynamics Division, Food Machinery and Chemical Corporation at 301 West Avenue 26, Los Angeles 31, California, or 2005 Northwestern Avenue, Indianapolis 8, Indiana.

*Putting Ideas to Work*

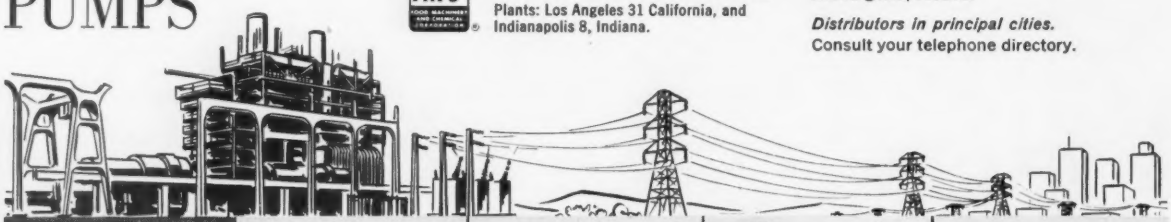
**PEERLESS PUMP**

HYDRODYNAMICS DIVISION

Plants: Los Angeles 31 California, and Indianapolis 8, Indiana.

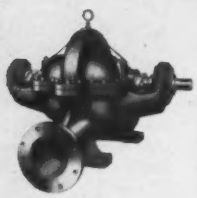
*Offices:* New York; Detroit; Chicago; Cleveland; Indianapolis; St. Louis; San Francisco; Atlanta; Plainview; Lubbock; Phoenix; Albuquerque; Los Angeles; Fresno.

*Distributors in principal cities.* Consult your telephone directory.



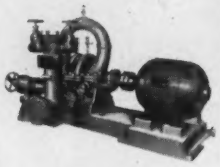
PEERLESS PUMPS

GET THE JOB DONE



**BOOSTER, CIRCULATING SERVICE**

Horizontal Split Case Peerless TYPE A offers widest possible application in water pumping. Broad range of capacities and heads. Request Bulletin B-1300.



**FIRE PREVENTION AND CONTROL**

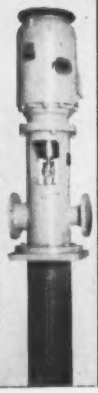
Select from vertical and horizontal FIRE PUMP models. All models are approved by Underwriters Lab and Associated Factory Mutual Fire Insurance Companies. Request Bulletin B-1500.

**CONDENSER CIRCULATING SERVICE**

Close Coupled HYDRO-FOIL pumps can be installed for wet or dry pit application. Extremely adaptable where space is limited. Request Bulletin B-148.

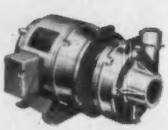
**COOLING TOWER SERVICE**

The Peerless lineup of VERTICAL INDUSTRIAL SERVICE pumps are extremely efficient, require little maintenance. Install them inside or outside. Request Bulletin B-505.



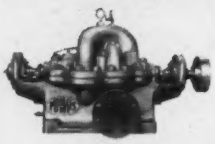
**HEATER DRAIN, CONDENSATE RETURN SERVICE**

Peerless HYDRO-LINE® pumps handle fluids up to 400°F. Will operate with any available NPSH. Request Bulletin B-1700.



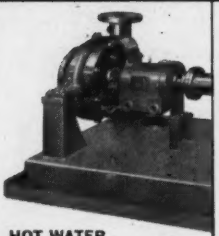
**IN-PLANT CHILLED WATER PUMPS**

End suction centrifugal FLUIDYNE® pumps are highly versatile in application, extremely efficient in service, and economical to operate. Models in all desired sizes. Request Bulletin B-2300.



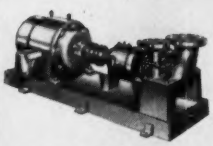
**EVAPORATOR FEED, BOILER WASH, HEATER DRAIN**

Peerless TU and TUT pumps have internal or loop cross-over, Multi-stage design allow pumps to develop high head and capacity from a compact unit. Request Bulletin B-1400.



**HOT WATER, TRANSFER CHEMICAL FEED**

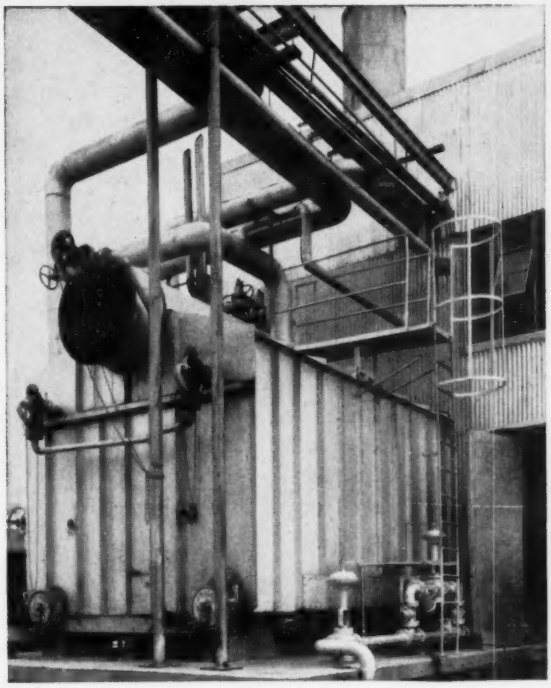
Select from a comprehensive line of Peerless TYPE DM AND DMR pumps. Unsurpassed for handling superheated water and chemical fluids. Request Bulletins B-1608, B-1610.

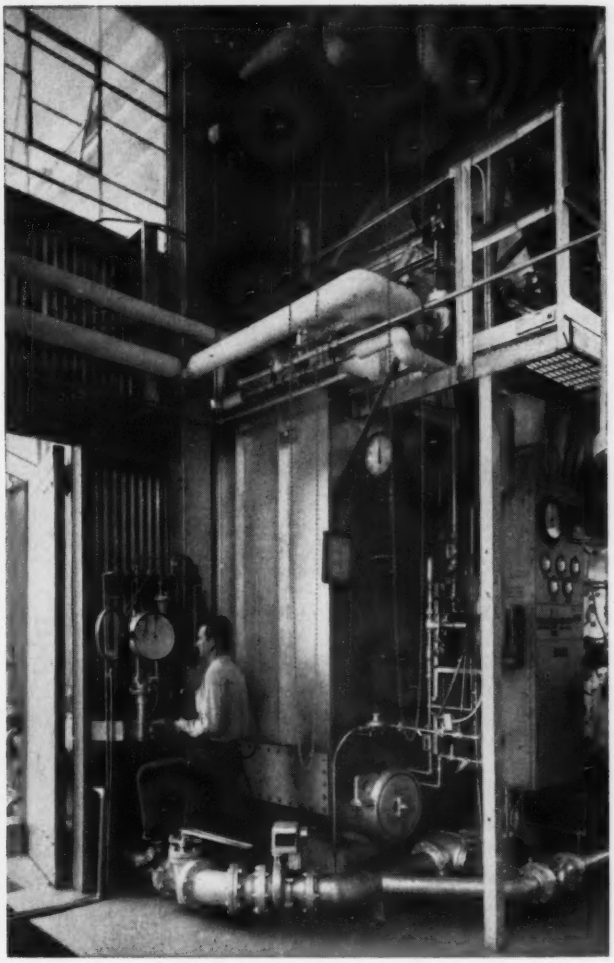


**BOILER LANCERS, HEATER DRAIN**

A heavy duty, packing gland type pump, the Peerless TYPE PR is specially designed for heavy pumping assignments. Handles hot or cold liquids with equal efficiency. Request Bulletin B-1605.

*Processing wallboard at Kaiser Gypsum*





# Union Packaged Boiler takes increased load in stride

A good part of the steam for processing gypsum wallboard at Kaiser Gypsum Company's Long Beach plant is supplied by the Union Type MH Packaged Boiler shown.

Semi-automatic fired with a normal operating pressure of 200 psi, this compact unit went on the job in 1956. Installed outdoors, it eliminated the need for further extension of the existing boiler house.

Although originally furnished to deliver steam for 2 out of 5 zones in a Coe Dryer, the MH was later hooked up to carry more of the load handled by an older boiler. Says the engineer-constructor, Kaiser Engineers: "The extra load demand on the Union Boiler was hardly noticeable from an operating standpoint."

Throughout industry, similar reports verify reliable Union performance on stiff assignments. Job-proved designs, complete shop assembly, compactness, easy installation and above average efficiency combine to make Union MH Steam Generators the best dollar-for-dollar buy on the market.

Readily equipped to handle a great diversity of needs formerly requiring costly field erection and special engineering, Union Packaged Steam Generators are now operating at capacities over 100,000 lbs./hr.

UNION

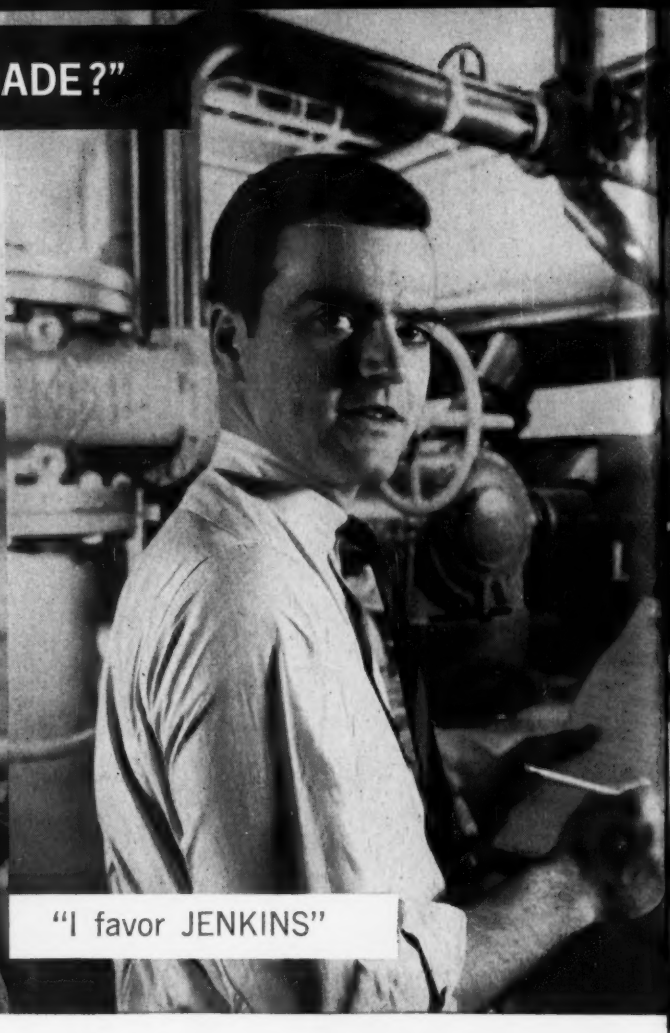
**UNION IRON WORKS**
**ERIE, PENNSYLVANIA**
**DIVISION OF RILEY STOKER CORP.**

**For more facts circle 241 on Reader Service card, p 121**

**Circle 242 on Reader Service card for following ad ➤**

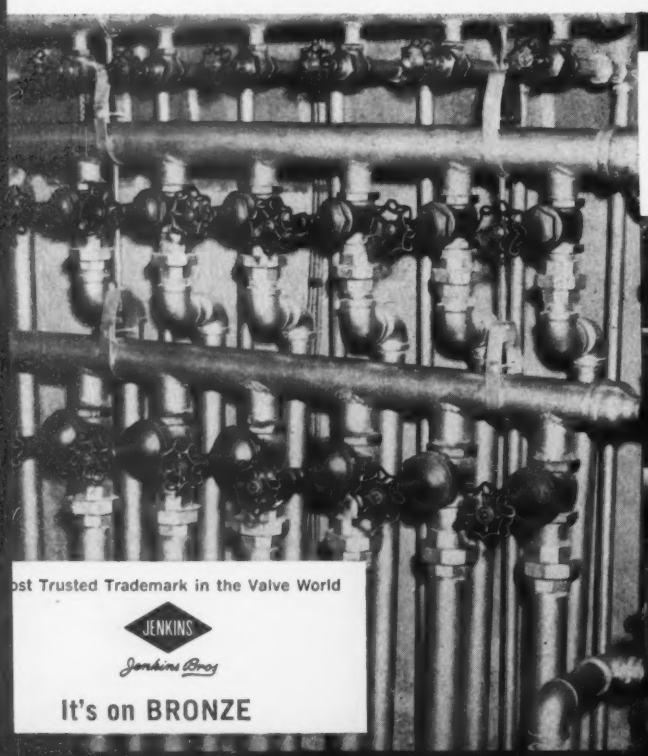
"WHAT'S THE BEST VALVE MADE?"

"JENKINS o'course"



"I favor JENKINS"

# Whatever The Type...It's A Good Feeling



ost Trusted Trademark in the Valve World

JENKINS

Jenkins Bros

It's on BRONZE

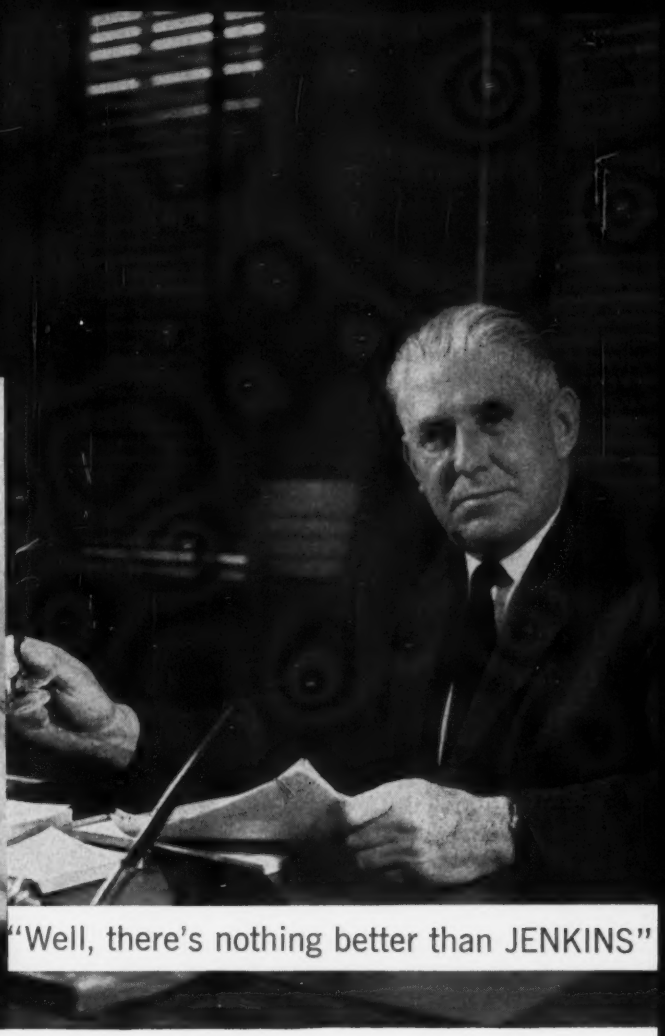
Most Trusted Trademark in the Valve World

JENKINS

Jenkins Bros

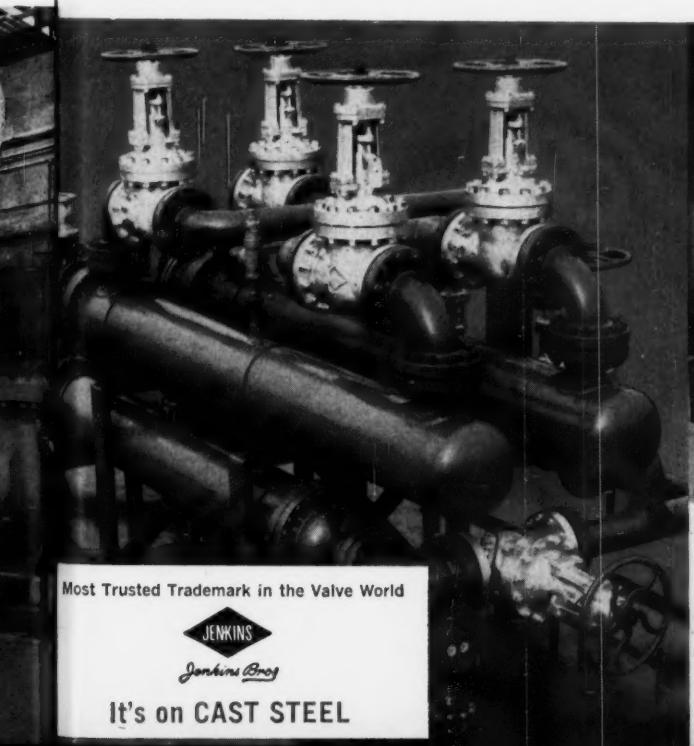
It's on IRON

"We specify JENKINS"



"Well, there's nothing better than JENKINS"

# g To Have The Valve Everyone Trusts

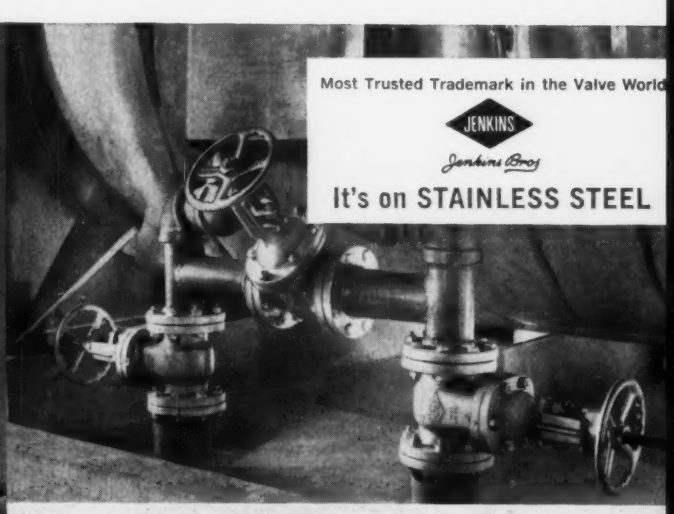


Most Trusted Trademark in the Valve World

JENKINS

Jenkins Bros

It's on CAST STEEL



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It's on STAINLESS STEEL

JENKINS

MOST TRUSTED TRADEMARK IN THE VALVE WORLD

VALVES

JENKINS SINCE 1864 Jenkins Bros

Sold Through Leading Distributors Everywhere

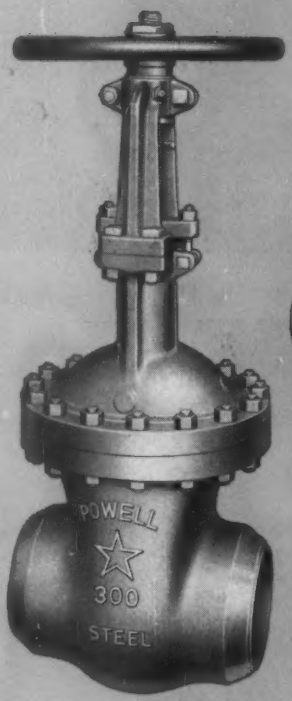
# YOU CAN COUNT ON POWELL VALVES

Performance proves it, year after year—you can count on Powell Valves to help you solve the toughest flow control problems of temperature and pressure found in power plants today.

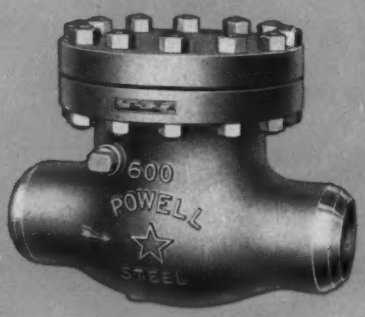
This truly dependable performance results from many things—among them Powell's engineering know-how, accumulated during 115 years of valve manufacture, and the consistent use of quality materials, quality controlled.

Then, too, you can count on getting the Powell Valve you need, when you need it. That's because Powell maintains a network of distributors backed up by factory inventories, warehoused "ready to go."

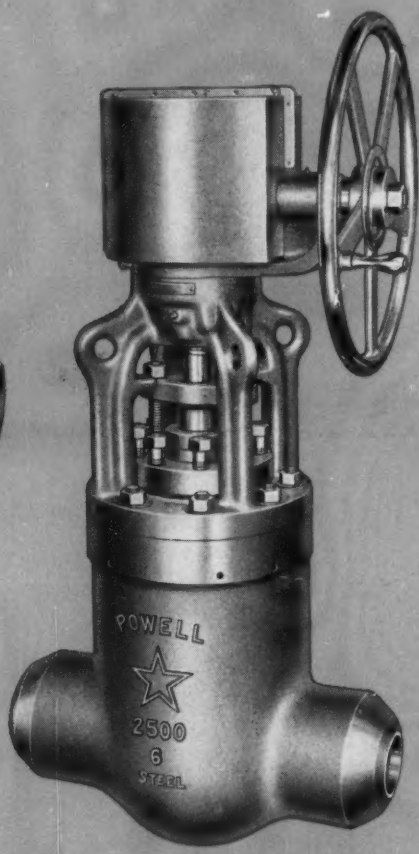
Get the full story from your nearby Powell Valve Distributor, or write us direct . . . The Wm. Powell Company, Cincinnati 22, Ohio.




300-pound Steel Gate Valve—Fig. 3003 WE. Bolted flanged yoke-bonnet. Outside screw rising stem. Interchangeable solid or split wedges, renewable seats. Sizes, 1" through 30".




600-pound Steel Horizontal Swing Check Valve—Fig. 6061 WE. Bolted cap, renewable seat and disc. Has full flow area when valve is fully open.




2500-pound Steel Pressure Seal Gate Valve—Fig. 125003 WE. Enclosed bevel gears facilitate operation. Valves can also be supplied with spur gearing or motor operators for remote control.

*115th year of manufacturing industrial valves for the free world*

**POWELL STEEL VALVES**

THE WM. POWELL COMPANY CINCINNATI 22, OHIO



For more facts circle 243 on Reader Service card, p 121

LOUIS N ROWLEY, EDITOR • JUNE 1961 • ESTABLISHED 1882 **Power**

# Milestone in Milwaukee

Back in 1909—on October 25 to be exact—a boiler explosion in a Milwaukee brewery killed one man, injured another and caused $250,000 damage. Except for one thing, this blast was like many others in the early years of the century, when boiler accidents were so common that POWER carried a regular column headed "Boiler explosions this month". The one difference? Milwaukee engineers did something about it!

For some years engineering organizations in that city had been agitating for the licensing of engineers and for a boiler-inspection law. With the brewery blast to lend dramatic point to their arguments, the drive to protect life and property gained new impetus. Less than 18 months later they accomplished their objective: On March 27, 1911, the Common Council of the City of Milwaukee adopted an ordinance creating a Board of Examiners of Stationary Engineers and an Inspector of Steam Power, Heating and Generating Apparatus.

Today, we are accustomed to a society in which such regulations are commonplace. It is the exception when a state or municipality fails to exert some control over the practice of the various forms of engineering and over the installation of equipment such as boilers and pressure vessels. Thus we may not immediately see why Milwaukee engineers are so proud of the 50th anniversary being celebrated this year. But the pride becomes clear and justifiable if we look at things as they were 50 years ago.

Then, only the first fumbling steps were being taken to curb the appalling toll of boiler accidents. A handful of states and cities had passed ordinances, and in the same year Milwaukee made its pioneering move, the American Society of Mechanical Engineers set up a committee to formulate standards for construction of boilers and pressure vessels. As we outlined on this page in January, the first ASME Boiler Code was issued in 1914, and in 1916 the Uniform Boiler and Pressure Vessel Laws Society began the long fight, not yet ended, for universal adoption of ASME-Code-based laws.

In looking back over this development we see the continuous intertwining of three factors: (1) the need for equipment that is designed and fabricated to the best technical standards of which we are capable (2) the need for skilled, responsible engineers to supervise its operation and maintenance, and (3) the need for unceasing vigilance to insure that equipment meets the standards when it is installed—and continues to do so. For all three, we as energy systems engineers have both an individual and a collective responsibility.

As individuals we are responsible for the sound selection, operation and maintenance of the apparatus in our own plants. This is a charge upon our professional integrity that is direct and clear. Less clear, perhaps, but equally important, is our responsibility as members of engineering organizations. Diffidence, expedience and narrow self-interest continuously threaten the progress that has been gained so painfully. We must make sure the potent influence of our engineering associations is continuously exerted to raise the standards of individual practice and to extend and strengthen the laws and regulations that have given the U.S. an enviably high boiler safety record.

Owner: **Western Hotels, Inc.**
Electrical Engineer: **Mr. Fritz Klawa,** Portland, Ore.
Electrical Contractor: **Pitman Electric Co.,** Portland, Ore.

# Electrical Protection is MODERNIZED with BUSS Fuses in the Multnomah Hotel, Portland, Ore.

**In this well-known hotel of the Northwest, it became necessary to modernize the electrical system to take full advantage of the many uses for electricity today.**

**BUSS Hi-Cap and FUSETRON dual-element fuses were installed to assure safe, dependable and lasting protection.**

**This installation is another example of the modern trend in electrical protection. Architects, engineers and plant operating men are finding no other type of protective device can equal fuses for high-interrupting capacity and lifetime, maintenance-free dependability.**

## FUSES PROVIDE HIGH INTERRUPTING CAPACITY

*at a very low cost*

**FUSETRON dual-element fuses have an interrupting rating of 100,000 ampere rms symmetrical—and for the protection of mains or circuits above 600 amperes, BUSS Hi-Cap fuses are designed to safely interrupt 200,000 ampere rms symmetrical.**

**Thus, they can safely interrupt fault currents now available,—and are adequately safe to allow for future system growth.**

*Mr. J. Wesley Birch, Manager of Pitman Electric Co. at main switch board which is equipped with BUSS Hi-Cap and FUSETRON dual-element fuses.*

*If you need fuses with* long time-lag to prevent needless blows, plus 200,000 amp interrupting capacity, plus extreme current-limitation— use **BUSS LOW-PEAK** fuses.

*Ask for BUSS bulletin LPCS.*

## WITH FUSES, SAFE PROTECTION REMAINS SAFE WITHOUT MAINTENANCE OR RECALIBRATION COSTS

**After years of inactivity, fuses will provide the same safe, accurate protection if called upon to open as they would on the day installed.**

**Fuses have no hinges, pivots or contacts to stick or get out of order. Dust, fumes, corrosion or age cannot increase the capacity of fuses or lengthen their blowing time.**

*For more information:*

Fusetron dual-element fuses.....write for bulletin FIS
BUSS Hi-Cap fuses.....write for bulletin HCS

**BUSSMANN MFG. DIVISION,** McGraw-Edison Co.
University at Jefferson, St. Louis 7, Mo.

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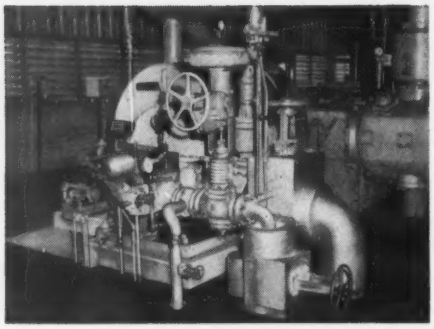
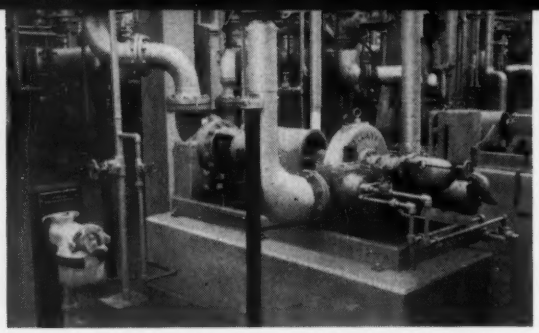
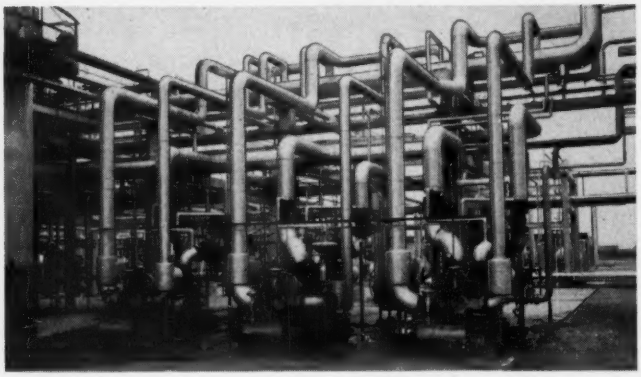


600-hp Elliott turbine driving a compressor which supplies compressed air for process.

(Right) Elliott steam turbines power many reflux pumps throughout the refinery. Shown here are three, driving gasoline column bottoms pumps in the crude unit.

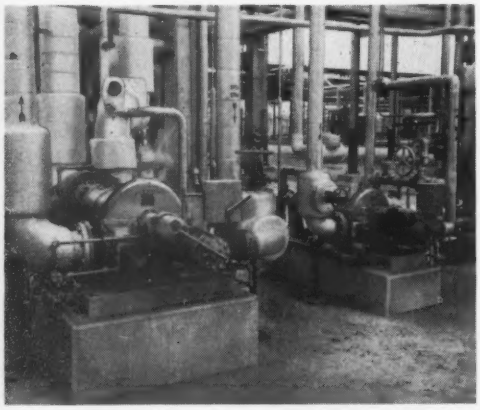


The YR turbine shown above drives an oil pump in the alkylation plant.

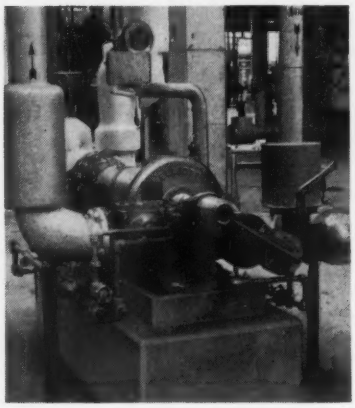


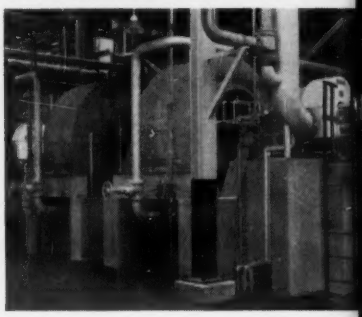
The turbine-driven condensate pump shown below charges foul condensate to stripper column.

Below are forced-draft fans driven by Elliott turbine-gear units in one of the refinery's boiler plants.



The unit on the left above is a condensate pump, and the one on the right is a seal oil and flushing oil pump. Both are driven by Elliott turbines.





FROM TURBINE HEADQUARTERS

# In one refinery, 85 Elliott turbines driving pumps, compressors, fans prove Elliott versatility

Ranging in size from 5 to 935 horsepower, these Elliott YR single stage turbines are installed in a giant East Coast Refinery. The units were selected from a modern, field-proven line of mechanical drive turbines rated up to 50,000 horsepower.

Installations like this together with experience of more than 50 years in turbine design, manufacture and application are among the reasons why Elliott is truly "Turbine Headquarters." Write for descriptive bulletin H22-D. H1-2

## ELLIOTT COMPANY

*GENERAL OFFICES: JEANNETTE, PENNSYLVANIA PLANTS AT: Jeannette and Ridgway, Pa.; Springfield, Ohio*

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For more facts circle 245 on Reader Service card, p 121

a **Power**
special report
June 1961

By T W EDWARDS, Associate Editor

# Valves

**The factors in selection . . . recent advances in materials and fluid-loss technology . . . a study of fluid-end types . . . valve actuators available . . . and finally, practical ideas on maintenance**

Valves are the controlling element in any fluid-handling system. This control may be on-off to isolate system components, modulation to regulate the system or direction monitoring for system protection. Without valves you could probably get your system going, but, like the Sorcerer's apprentice, you could neither make it do its job right nor shut it down. It would work on and on aimlessly, filling the cistern to overflowing.

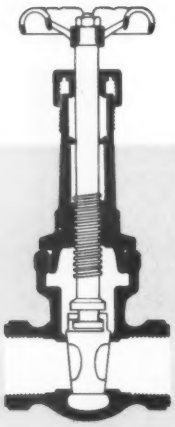
The history of valves parallels that of piping. In the days of the Roman Empire they used wooden valves that bore a striking resemblance to our present-day plug valve. With the advent of metal piping came our basic valve designs—gate and globe types. In recent years, valve technology has expanded to keep up with the sophisticated needs of modern energy systems. Expansion has been along many fronts—basic valve designs, materials of construction and actuators to operate valve liquid-ends either manually or automatically.

Valves are found in almost all energy systems: modern steam-generation cycles call upon valve technology in the pressure-temperature area; water treatment and waste disposal pose severe chemical-handling problems. Wholly new low-temperature materials have been developed for cryogenic systems, and even the garden-variety uses demand greater reliability because of soaring maintenance costs.

This special report is a companion to POWER's June 1960 report, *Piping*. They're both aimed at energy-systems engineers whose work requires close contact with fluid-systems technology, but who do not design these systems day in and day out. And valve specialists, too, will find them valuable as comprehensive and current reviews.

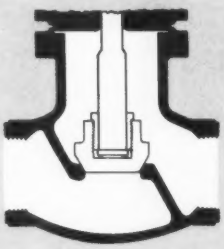
Bringing together in one place essential data on today's wide variety of valves, this report lets you make an informed choice. In the next 23 pages you will find up-to-date data on selection factors, materials, fluid losses, standards and the hardware of valve liquid-ends and actuators. Maintenance tips, installation and operation hints round out the picture for most energy-systems valve applications.

# ENERGY-SYSTEMS VALVES in many



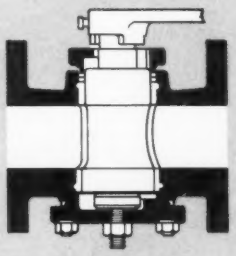
**Gate**

For on-off operation the gate valve seals tight in either direction. Straight-through flow path keeps friction loss down



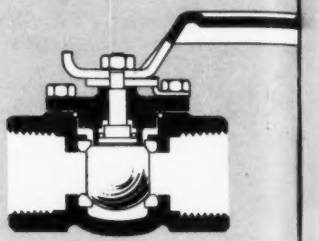
**Globe**

Basic control valve is the globe. Changes in flow direction can up friction; special types lower wide-open loss



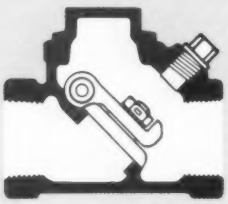
**Plug**

Space-saving plug needs only a quarter turn from open to dead shut. Special materials handle difficult fluids



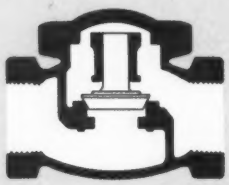
**Ball**

Ball-valve designs, a recent adaptation of plugs, combine simplified sealing with the same space-saving advantage



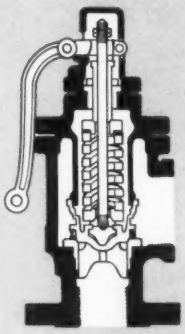
**Swing check**

Low fluid-friction losses are typical of the swing check valve. It can't hang up wide open; closing is positive



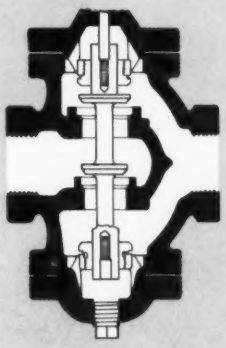
**Piston check**

Reverse flow starts a positive seating action in piston check valves. Designs are spring loaded or pressure actuated



**Safety**

Pressure equipment in an energy system is protected by relief or safety valves designed for positive operation



**Balanced**

Valve-stem operating force is minimized in balanced valves. Port openings vary to change the rate of fluid flow

## Valve selection depends on six vital factors covering fluid properties,

**Success or failure of any fluid-handling system depends greatly on proper valve application. Fluid properties, type of service and operating conditions are broad areas covered in detail by the six factors governing valve selection. All these factors must be carefully considered for each and every valve. You're courting trouble if you assume that some of them are constant throughout the system. Temperature and pressure can vary from one location to the next. The fluid itself may change in character. If these variables are not taken into account during selection, money spent originally for valves may be largely wasted by unnecessary repair and repeated valve replacement.**

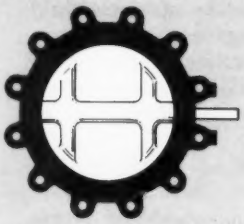
### 1—Fluid properties

At the very outset of selection, the fluid handled in the system must be clearly outlined. Is it a true fluid or does it contain solids; is it a liquid throughout the system or does it vaporize at some point and become a gas? If the fluid starts as a gas may it later liquefy? Under the physical operating conditions in the system, what are its corrosive characteristics? In this connection, be sure to consider all components of the fluid—a mixture of fluids can have corrosive properties that are totally different from any of the fluids considered separately.

### 2—Valve size

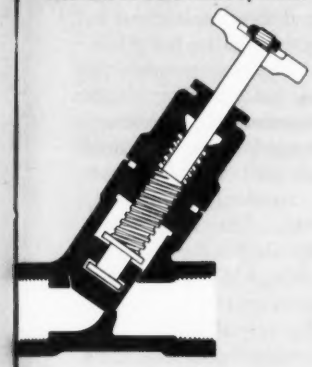
In the design of a fluid-handling system, pipe size is normally selected first in accord with capacity needs and permissible fluid-friction losses. It's rare that any valve feature justifies changing this size, although accumulated fluid-friction losses through all valves may have been a factor when determining pipe size in the first place. Remember, valve size and available materials go hand in hand. Brass valves are usual in common water services up

# forms tackle variety of fluid-handling tasks



**Butterfly**

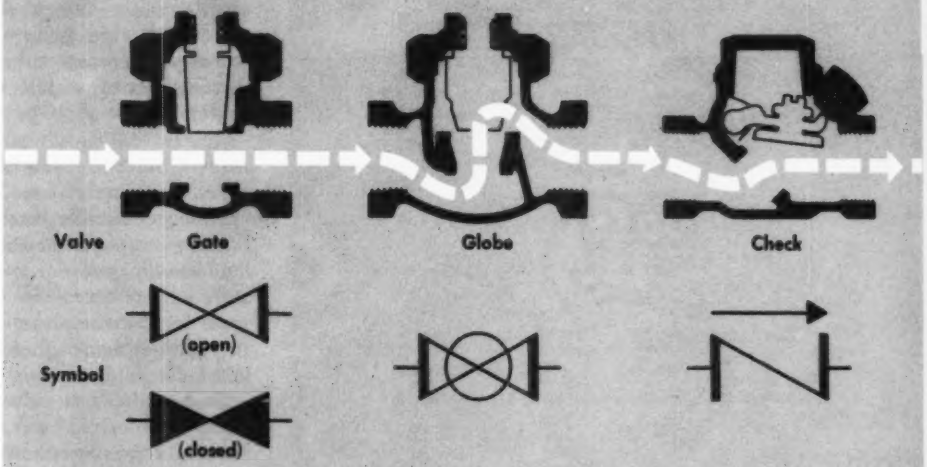
Although far from a new type, the butterfly valve is gaining as a final control element in automatic systems



**Plastic**

Highly corrosive services employ valves of solid plastic. Plastic-lined metal valves cope with higher pressure

**Every valve serves one or more of three basic functions**




Every valve in an energy system provides one or more of three basic functions—on-off, modulating control, direction monitoring. Flow patterns through the valves performing these basic services, top drawings, hint at the pressure-loss characteristics of each. Gate valves for simple on-off operation keep fluid-friction losses to a minimum with a straight-through flow path. Globe valves for modulating control usually alter flow direction —sometimes radically—generating friction losses. Check valves, normally self operating, monitor flow direction; losses here vary from high to quite low according to design. As an aid in graphically representing valve types on design drawings, symbols above are standard.

## system pressure-temperature and type of service

through the 2-inch size. Iron-body valves are used in the larger sizes. More extreme services demand steel valves, forged up through the 2-inch size with larger ones cast.

### 3—Valve service

Type of valve needed is dictated by the job at hand. Simple shutoff usually calls for a gate or similar on-off valve. When either manual or automatic modulating control is required, one of many globe designs may be the best bet. To prevent flow reversal, install one of the check-valve types. Fluids such as paper pulp, which carry solids likely to jam under the seat of a gate valve, are best handled by a plug or ball type valve.

### 4—Fluid-friction loss

Fluid-friction loss and pressure drop are getting much attention. In the past designers simply had to live with the inherent high friction loss of globe valves employed for flow control. But recent development work has made great strides in reducing wide-open losses through many globe-valve and check-valve types.

### 5—Pressure and temperature

Pressures and temperatures often vary widely within a given fluid-handling circuit, affecting valve selection. ASA and other Standards have been set for pressure-temperature relationships and manufacturers so rate their valves.

### 6—Materials of construction

After pressure, temperature and fluid characteristics are fixed, materials of construction can be intelligently selected. Most valve designs are available in several different materials for valve bodies and bonnets and for the disk or plug and its mating seats. As a general rule, consider each of these associated parts separately. Next three pages show how to select proper materials for each valve.

## Use this guide for materials selection

| Fluid service | Body and major parts | Trim |
|---|---|---|
| Acetic acid | Aluminum, Ni-resist, bronze | Bronze, monel, stainless |
| Acetone | Brass, steel, iron | Bronze |
| Air | Iron, steel, brass, plastic | Bronze, plastic |
| Ammonia | Iron, steel, Ni-resist, stainless | Steel, stainless |
| Brine | Iron, steel, Ni-resist, brass, monel, plastic | Bronze, monel, plastic |
| Calcium chloride | Iron, steel, Ni-resist, brass, aluminum, stainless | Bronze, monel, stainless |
| Calcium hydroxide | Iron, steel, stainless | Stainless, monel |
| Carbonic acid | Brass, stainless, aluminum, Ni-resist | Bronze, stainless |
| Carbon tetrachloride | Iron, steel, Ni-resist, brass, stainless | Bronze, monel, stainless |
| Chlorine—dry gas | Brass, iron, steel, plastic | Bronze, plastic |
| Chromic acid | Iron, stainless | Stainless |
| Citric acid | Bronze, Ni-resist, copper, stainless, aluminum | Bronze, monel, stainless |
| Coal-tar solvents | Iron, steel, Ni-resist | Stainless, monel |
| Copper sulfate | Stainless | Stainless |
| Creosote | Iron, steel | Stainless, monel |
| Gelatine | Aluminum, stainless | Stainless, monel |
| Glucose | Iron, steel, brass | Bronze, monel, stainless |
| Hydrochloric acid | Bronze, Hastelloy C, plastic | Bronze, monel, Hastelloy C, plastic |
| Hydrogen peroxide | Aluminum, stainless, Ni-resist | Stainless |
| Hydrogen sulfide | Stainless, Ni-resist, aluminum | Stainless |
| Nitric acid | Stainless, plastic | Stainless, plastic |
| Oxygen | Steel, brass, stainless | Bronze, stainless |
| Phenol | Iron, steel, brass, bronze, stainless, aluminum | Bronze, stainless |
| Phosphoric acid | Stainless, Ni-resist, plastic | Bronze, stainless, plastic |
| Potassium hydroxide | Iron, steel, Ni-resist, stainless | Stainless, monel |
| Soap | Iron, steel, brass, bronze, stainless | Bronze, stainless, monel |
| Sodium carbonate | Iron, steel, Ni-resist, stainless | Bronze, stainless |
| Sodium hydroxide | Iron, steel, Ni-resist, stainless | Stainless, monel |
| Sodium phosphate | Stainless, Ni-resist | Stainless |
| Sodium sulfate | Iron, steel, Ni-resist, stainless | Bronze, stainless, monel |
| Sulfate liquors | Iron, steel, Ni-resist, stainless | Stainless, monel |
| Sulfuric acid | Iron, Ni-resist, bronze, stainless, plastic | Bronze, monel, stainless, plastic |
| Sulfurous acid | Bronze, stainless | Bronze, stainless |
| Tannic acid | Brass, bronze, Ni-resist, stainless | Bronze, monel, stainless |
| Water—distilled (demineralized) | Stainless, aluminum, plastic | Stainless, plastic |
| Water—mine | Iron, steel, Ni-resist, bronze, stainless | Bronze, stainless, monel |
| Water—sea | Iron, steel, Ni-resist, plastic, bronze, copper, stainless | Bronze, stainless, monel, plastic |

# Materials technology copes with

**Materials technology is on the move. Both new and improved energy-systems materials are coming down the pike—as they must to meet increasingly severe operating conditions and handle new fluid applications. Every design engineer must keep pace with this progress. Otherwise he is apt to overdesign, waste money or fail to consider new developments which might greatly simplify his materials-selection problem.**

All six valve-selection factors mentioned on previous pages are interrelated, but the importance of proper materials demands special attention when choosing valves for an energy system. Materials commonly employed for fluid handling range from iron and bronze for low-temperature low-pressure water service to sophisticated stainless steels for extreme pressure-temperature steam conditions. In addition, many other metals and nonmetals stand by to handle fluids ranging from acetic acid to sea water.

Table at left lists valve body and trim materials ordinarily used for the many fluids encountered. Your choice between alternatives shown will depend upon temperature, pressure—and the corrosive characteristics of the fluid under these operating conditions.

When selecting valve materials, consider the valve body separately from trim (including seats). This will produce the optimum combination of materials for the valve. In control valves particularly, where liquid velocities increase at point of control, erosion can be the decisive factor in trim selection. Seats and plugs take the beating here and, especially with solids-carrying liquids, the extra cost of extremely hard materials usually pays off.

Cast-iron valves in general are used on water service up to temperatures of about 450 F, brass valves up to about 550 F. At higher temperatures steel is a common selection. As temperatures rise above 775 F, steel alloys such as the carbon-molybdenums, chrome-molybdenums and chrome-nickel-molybdenums come into play. For valve trim, brass is satisfactory up to about 550 F—but it's seldom used with steel valves except in marine service.

Plastics for valves are out of the "interesting newcomer" category and settling down to a good day's work as an accepted energy-systems material. Many specific compositions are available to meet the corrosive conditions imposed by previously hard-to-handle chemicals. Weak acids are a good example—here corrosion rate shoots up in comparison to the relatively slight amount of corrosion produced by the same acid in concentrated form. In the latter case an all-iron valve might well suffice.

In addition, plastic valves are employed satisfactorily in many mildly corrosive systems—usually below 150 psig, 150 F. Here they replace the more sophisticated stainless steels, which are somewhat heavier and also more expensive than these intermediate service conditions really demand. Cost is down, adequate operation almost universally reported. A sea-water cooling system is one such application.

Where pressure exceeds the limit for plastics, plastic-lined valves made of iron or steel give added strength without sacrificing the benefits of corrosion resistance.

# more corrosive fluids, higher pressures and temperatures

Another new material for valve application is nodular (ductile) iron. This is made by adding alloys of magnesium or cerium to the molten gray iron. Addition causes graphite to form as small nodules instead of the normal flakes found in gray cast iron. High tensile strength and ductility result. Benefits: corrosion resistance of cast iron combined with strength and ductility of steel; reduced susceptibility to fracture from thermal or physical shock.

Since chrome-steel valves present touchy field-welding problems of pre and post heat treatment, they are frequently provided with carbon-steel ends which the manufacturer welds on in his shop. Then field welding these carbon-steel valve ends to piping and other fittings eases on-site assembly of the piping system. Under shop conditions the chrome-to-carbon-steel welding process is greatly simplified and can be closely controlled for the best-possible weld. Also, shop inspection techniques can be more thorough than comparable field techniques.

ASTM specifications summarized at right cover both high-pressure and extreme-temperature applications. Since extreme pressures and temperatures actually change characteristics of the material, valve ratings and materials change along with temperature and pressure. Very-low temperature materials listed are gaining interest as progress in cryogenics increases potential applications.

Table on next page, adapted from American Standards Association Standard B16.5-1957, shows allowable pressures for ASTM-spec materials at temperatures up to 1250 F. However, *only data for pressure ratings up through 2500 psig are taken from the ASA.*

The 4500-psig ratings are a proposed standard only and essentially amount to three times the 1500-psig figures. Although not as yet adopted by the American Standards Association, these 4500-psig ratings are currently employed by some valve manufacturers and users to satisfy the extremely high temperature-pressure conditions imposed by supercritical steam-generating stations. Increasing need for this proposed standard—or another satisfactory solution to the problem—is the driving force behind current work in this important area. As more and more supercritical units are planned by U.S. utilities, the desirability for industry standardization becomes greater and greater. Undoubtedly, higher-pressure ratings will become an official part of the ASA Standard as soon as their adequacy is clearly established.

Very small valves with socket-weld ends are not always rated according to the flanged-connection-based ASA B16.5-1957, but manufacturers' ratings are conservative and in essential agreement with forged-steel-fitting Standards (MSS SP-49). On the other hand, these small designs take a big slice of the market—about 25% of *all* valves for modern steam-generating stations fall in this category. Lack of a Standard for socket-weld-end valves is unfortunate. But work in this direction is progressing and one may soon be published.

A word of caution: when using the pressure-rating table on next page, remember that pressures shown are for non-shock duty only. Where the system is likely to impose shock loading on valves—water hammer is an example—add a suitable margin to figures obtained from the table.

## ASTM specs cover materials suited for pressure-temperature extremes

| ASTM spec no. | Service and description |
|---|---|
| A216 Grade WCB *(A105 Grade II)* | Carbon steel. Regularly used in all 150-, 300- and 600-lb valves. If long service at high temperature is anticipated, you should watch out for the possibility of graphite formation in flanged or screwed-end valves above 800 F and in welding-end valves above 775 F |
| A217 Grade WC1 | Carbon-molybdenum steel. Suitable for slightly higher pressures than carbon steel at temperatures above 650 F. If long service at temperatures above 875 F is anticipated, you should watch out for the possibility of graphite formation |
| A217 Grade WC6 *(A182 Grade F11)* | 1¼%-chrome ½%-moly steel. For temperatures up to 1000 F |
| A217 Grade WC9 *(A182 Grade F22)* | 2¼%-chrome 1%-moly steel. For temperatures between 1000 and 1050 F |
| A217 Grade C5 | 4-to-6%-chrome ½%-moly steel for high-temperature corrosive oil service |
| A217 Grade C12 | 8-to-10%-chrome 1%-moly steel for high-temperature corrosive oil service |
| A351 Grade CF8M *(A182 Grade F8M)* | 18%-chrome 8%-nickel moly steel for temperatures up to 1250 F |
| A352 Grade LCB | A carbon steel for low-temperature applications to —50 F |
| A352 Grade LC1 | A carbon-moly steel for low-temperature applications to —75 F |
| A352 Grade LC3 | A low-carbon 3½%-nickel steel for low-temperature applications to —100 F or somewhat lower |

Main ASTM spec numbers given above are for castings. The alternate numbers *(in italics)* are ASTM specs for forgings, where applicable

# Pressure-temperature ratings help you select the right valve for each service

| Primary service pressure ratings | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 | 4500 |
|---|---|---|---|---|---|---|---|---|
| Hydrostatic shell test pressure | 425 | 1100 | 1450 | 2175 | 3250 | 5400 | 9000 | 16,200 |

| Service temperatures, F | Materials—ASTM specification alloy grade designation | Service pressure rating (maximum nonshock) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| −20 to 100 | | 275 | 720 | 960 | 1440 | 2160 | 3600 | 6000 | 10,800 |
| 150 | | 255 | 710 | 945 | 1420 | 2130 | 3550 | 5915 | 10,650 |
| 200 | | 240 | 700 | 930 | 1400 | 2100 | 3500 | 5830 | 10,500 |
| 250 | WCB | 225 | 690 | 920 | 1380 | 2070 | 3450 | 5750 | 10,350 |
| 300 | WC1 | 210 | 680 | 910 | 1365 | 2050 | 3415 | 5690 | 10,245 |
| 350 | WC6 | 195 | 675 | 900 | 1350 | 2025 | 3375 | 5625 | 10,125 |
| 400 | WC9 | 180 | 665 | 890 | 1330 | 2000 | 3330 | 5550 | 9990 |
| 450 | C5 | 165 | 650 | 870 | 1305 | 1955 | 3255 | 5430 | 9765 |
| 500 | C12 | 150 | 625 | 835 | 1250 | 1875 | 3125 | 5210 | 9375 |
| 550 | CF8M | 140 | 590 | 790 | 1180 | 1775 | 2955 | 4925 | 8865 |
| 600 | | 130 | 555 | 740 | 1110 | 1660 | 2770 | 4620 | 8310 |
| 650 | | 120 | 515 | 690 | 1030 | 1550 | 2580 | 4300 | 7740 |
| | WCB | 110 | 470 | 635 | 940 | 1410 | 2350 | 3920 | 7050 |
| | WC1 | 110 | 480 | 640 | 960 | 1440 | 2400 | 4000 | 7200 |
| | WC6 | 110 | 485 | 645 | 965 | 1450 | 2415 | 4025 | 7245 |
| 700 | WC9 | 110 | 485 | 645 | 965 | 1450 | 2415 | 4025 | 7245 |
| | C5 | 110 | 485 | 645 | 965 | 1450 | 2415 | 4025 | ---- |
| | C12 | 110 | 485 | 645 | 965 | 1450 | 2415 | 4025 | ---- |
| | CF8M | 110 | 495 | 660 | 985 | 1480 | 2465 | 4110 | 7395 |
| | WCB | 100 | 425 | 575 | 850 | 1275 | 2125 | 3550 | 6375 |
| | WC1 | 100 | 445 | 590 | 890 | 1330 | 2220 | 3700 | 6660 |
| | WC6 | 100 | 450 | 600 | 900 | 1350 | 2250 | 3745 | 6750 |
| 750 | WC9 | 100 | 450 | 600 | 900 | 1350 | 2250 | 3745 | 6750 |
| | C5 | 110 | 485 | 645 | 965 | 1450 | 2415 | 4025 | ---- |
| | C12 | 100 | 450 | 600 | 900 | 1350 | 2250 | 3745 | ---- |
| | CF8M | 100 | 470 | 625 | 940 | 1410 | 2355 | 3920 | 7065 |
| | WCB | 92 | 365 | 490 | 730 | 1100 | 1830 | 3050 | 5490 |
| | WC1 | 92 | 410 | 545 | 815 | 1225 | 2040 | 3400 | 6120 |
| | WC6 | 92 | 415 | 555 | 835 | 1250 | 2080 | 3470 | 6240 |
| 800 | WC9 | 92 | 415 | 555 | 835 | 1250 | 2080 | 3470 | 6240 |
| | C5 | 92 | 415 | 555 | 835 | 1250 | 2080 | 3470 | ---- |
| | C12 | 92 | 415 | 555 | 835 | 1250 | 2080 | 3470 | ---- |
| | CF8M | 92 | 450 | 595 | 895 | 1345 | 2240 | 3730 | 6720 |
| | WCB* | 82 | 300 | 400 | 600 | 900 | 1500 | 2500 | 4500 |
| | WC1 | 82 | 370 | 495 | 745 | 1115 | 1860 | 3100 | 5580 |
| | WC6 | 82 | 385 | 510 | 765 | 1150 | 1915 | 3190 | 5745 |
| 850 | WC9 | 82 | 385 | 510 | 765 | 1150 | 1915 | 3190 | 5745 |
| | C5 | 82 | 385 | 510 | 765 | 1150 | 1915 | 3190 | ---- |
| | C12 | 82 | 385 | 510 | 765 | 1150 | 1915 | 3190 | ---- |
| | CF8M | 82 | 425 | 565 | 850 | 1275 | 2125 | 3540 | 6375 |
| | WCB* | 75 | 260 | 350 | 525 | 785 | 1305 | 2180 | ---- |
| | WC1* | 75 | 355 | 470 | 710 | 1060 | 1770 | 2950 | ---- |
| | WC6 | 75 | 365 | 490 | 735 | 1100 | 1830 | 3055 | 5490 |
| 875 | WC9 | 75 | 365 | 490 | 735 | 1100 | 1830 | 3055 | 5490 |
| | C5 | 75 | 365 | 490 | 735 | 1100 | 1830 | 3055 | ---- |
| | C12 | 75 | 365 | 490 | 735 | 1100 | 1830 | 3055 | ---- |
| | CF8M | 75 | 415 | 550 | 825 | 1240 | 2070 | 3445 | 6210 |
| | WCB* | 70 | 225 | 295 | 445 | 670 | 1115 | 1855 | ---- |
| | WC1* | 70 | 335 | 450 | 670 | 1010 | 1680 | 2800 | ---- |
| | WC6 | 70 | 350 | 465 | 700 | 1050 | 1750 | 2915 | 5250 |
| 900 | WC9 | 70 | 350 | 465 | 700 | 1050 | 1750 | 2915 | 5250 |
| | C5 | 70 | 350 | 465 | 700 | 1050 | 1750 | 2915 | ---- |
| | C12 | 70 | 350 | 465 | 700 | 1050 | 1750 | 2915 | ---- |
| | CF8M | 70 | 400 | 535 | 805 | 1205 | 2010 | 3350 | 6030 |
| | WCB*† | 60 | 190 | 250 | 375 | 565 | 945 | 1570 | ---- |
| | WC1*† | 60 | 320 | 425 | 635 | 955 | 1590 | 2650 | ---- |
| | WC6 | 60 | 335 | 445 | 665 | 1000 | 1665 | 2775 | 4995 |
| 925 | WC9 | 60 | 335 | 445 | 665 | 1000 | 1665 | 2775 | 4995 |
| | C5 | 60 | 335 | 445 | 665 | 1000 | 1665 | 2775 | ---- |
| | C12 | 60 | 335 | 445 | 665 | 1000 | 1665 | 2775 | ---- |
| | CF8M | 60 | 390 | 520 | 780 | 1175 | 1955 | 3260 | 5865 |
| | WCB*† | 55 | 155 | 205 | 310 | 465 | 770 | 1285 | ---- |
| | WC1*† | 55 | 300 | 400 | 600 | 900 | 1500 | 2500 | ---- |
| | WC6 | 55 | 315 | 420 | 635 | 950 | 1585 | 2640 | 4755 |
| 950 | WC9 | 55 | 315 | 420 | 635 | 950 | 1585 | 2640 | 4755 |
| | C5 | 55 | 315 | 420 | 635 | 950 | 1585 | 2640 | ---- |
| | C12 | 55 | 315 | 420 | 635 | 950 | 1585 | 2640 | ---- |
| | CF8M | 55 | 380 | 505 | 760 | 1140 | 1900 | 3165 | 5700 |

| | 150 | 300 | 400 | 600 | 900 | 1500 | 2500 | 4500 |
|---|---|---|---|---|---|---|---|---|
| | 425 | 1100 | 1450 | 2175 | 3250 | 5400 | 9000 | 16,200 |

| Service temperatures, F | Materials—ASTM specification alloy grade designation | Service pressure rating (maximum nonshock) | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | WCB*† | 50 | 120 | 160 | 240 | 360 | 600 | 1000 | ---- |
| | WC1*† | 50 | 280 | 370 | 555 | 835 | 1395 | 2320 | ---- |
| | WC6 | 50 | 300 | 400 | 600 | 900 | 1500 | 2500 | 4500 |
| 975 | WC9 | 50 | 300 | 400 | 600 | 900 | 1500 | 2500 | 4500 |
| | C5 | 50 | 300 | 400 | 600 | 900 | 1500 | 2500 | ---- |
| | C12 | 50 | 300 | 400 | 600 | 900 | 1500 | 2500 | ---- |
| | CF8M | 50 | 370 | 490 | 735 | 1105 | 1840 | 3070 | 5520 |
| | WCB*† | 40 | 85 | 115 | 170 | 255 | 430 | 715 | ---- |
| | WC1*† | 40 | 215 | 285 | 430 | 645 | 1070 | 1785 | ---- |
| | WC6 | 40 | 265 | 355 | 535 | 800 | 1335 | 2230 | 4005 |
| 1000 | WC9 | 40 | 265 | 355 | 535 | 800 | 1335 | 2230 | 4005 |
| | C5 | 40 | 250 | 335 | 500 | 750 | 1250 | 2085 | ---- |
| | C12 | 40 | 290 | 390 | 585 | 875 | 1455 | 2430 | ---- |
| | CF8M | 40 | 355 | 475 | 715 | 1070 | 1785 | 2975 | 5355 |
| | WC9 | -- | 235 | 310 | 465 | 700 | 1165 | 1945 | 3495 |
| 1025 | C5 | -- | 215 | 285 | 430 | 645 | 1070 | 1785 | ---- |
| | C12 | -- | 240 | 320 | 480 | 720 | 1200 | 2000 | ---- |
| | CF8M | -- | 345 | 460 | 690 | 1035 | 1725 | 2880 | 5175 |
| | WC9 | -- | 200 | 265 | 400 | 595 | 995 | 1655 | 4500 |
| 1050 | C5 | -- | 180 | 240 | 355 | 535 | 890 | 1485 | ---- |
| | C12 | -- | 190 | 250 | 375 | 565 | 945 | 1570 | ---- |
| | CF8M | -- | 335 | 445 | 670 | 1000 | 1670 | 2785 | 5010 |
| | WC9* | -- | 170 | 230 | 345 | 515 | 855 | 1430 | 2565 |
| 1075 | C5 | -- | 145 | 195 | 290 | 435 | 730 | 1215 | ---- |
| | C12 | -- | 150 | 200 | 300 | 455 | 755 | 1255 | ---- |
| | CF8M | -- | 325 | 430 | 645 | 970 | 1615 | 2690 | 4845 |
| | WC9* | -- | 145 | 190 | 290 | 430 | 720 | 1200 | 2160 |
| 1100 | C5 | -- | 115 | 150 | 225 | 340 | 565 | 945 | ---- |
| | C12 | -- | 115 | 150 | 225 | 340 | 565 | 945 | ---- |
| | CF8M | -- | 310 | 415 | 625 | 935 | 1555 | 2595 | 4665 |
| | WC9* | -- | 125 | 165 | 240 | 370 | 615 | 1030 | 1845 |
| 1125 | C5 | -- | 95 | 125 | 190 | 285 | 470 | 785 | ---- |
| | C12 | -- | 95 | 125 | 190 | 285 | 470 | 785 | ---- |
| | CF8M | -- | 300 | 400 | 600 | 900 | 1500 | 2500 | 4500 |
| | WC9* | -- | 105 | 135 | 205 | 310 | 515 | 855 | 1545 |
| 1150 | C5 | -- | 75 | 100 | 105 | 225 | 375 | 630 | ---- |
| | C12 | -- | 75 | 100 | 105 | 225 | 375 | 630 | ---- |
| | CF8M | -- | 290 | 390 | 585 | 875 | 1455 | 2430 | 4365 |
| | WC9*† | -- | 85 | 115 | 170 | 255 | 430 | 715 | 1290 |
| 1175 | C5 | -- | 65 | 85 | 125 | 190 | 315 | 530 | ---- |
| | C12 | -- | 65 | 85 | 125 | 190 | 315 | 530 | ---- |
| | CF8M | -- | 260 | 350 | 525 | 785 | 1310 | 2185 | 3930 |
| | WC9*† | -- | 70 | 90 | 135 | 205 | 345 | 570 | 1035 |
| 1200 | C5 | -- | 50 | 70 | 105 | 155 | 225 | 430 | ---- |
| | C12 | -- | 50 | 70 | 105 | 155 | 225 | 430 | ---- |
| | CF8M | -- | 235 | 310 | 465 | 700 | 1165 | 1945 | 3495 |
| 1250 | CF8M | -- | 180 | 240 | 365 | 545 | 910 | 1515 | ---- |

* Product used within the jurisdiction of Section I, Power Boilers, of the ASME Boiler and Pressure Vessel Code is subject to the maximum-temperature limitations placed upon the material in Table P-7 of Section I

† Product used within the jurisdiction of Section I, Power Piping, of the ASA Code for Pressure Piping B31.1 is subject to the maximum-temperature limitations placed upon piping of the same general composition in Table 2a of ASA B31.1

**This table is adapted from ASA Standard B16.5-1957 for pressure ratings up through the 2500-psi class. 4500-psi ratings shown are taken from a *proposed* standard**

# Fluid-friction losses vary with smoothness of flow path

**Fluid-friction losses are the subject of almost continuous study. Losses attributable to valves make up a major portion of the total loss in many fluid-handling systems. But valve manufacturers are constantly developing new configurations to minimize these energy losses, reduce operating cost.**

This is especially true in globe valves used for control purposes. Here, fluid control is provided by artificially creating fluid friction within the valve itself. But, when the valve is wide open and not working at its control function it is frequently desirable to minimize these same losses.

Extensive studies and experimental work provide the solution. Compare the internal waterways of two otherwise-similar control valves at right. Standard valve, top, has sharp corners, abrupt changes in cross section—and hence in velocity. These factors create turbulence, increasing fluid-friction losses. The special low-loss valve, below right, has carefully contoured internal waterways to guide flow through the valve while gradually altering cross section and velocity. Minimum turbulence results in low fluid-energy loss.

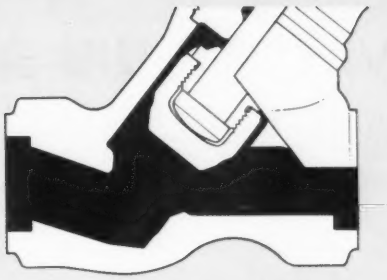
In addition, these special low-loss valves usually have carefully polished interior surfaces and other special features designed to keep internal losses to an absolute minimum. Obviously they cost more to make, a factor which must be balanced against pumping-power gains.

Potential benefits derived from improved internal design are best illustrated by comparing valve friction-loss factors. On p 63 of POWER's special report on *Piping*, June 1960, fluid-loss factors—$k$ factors—are listed for valves of various types. These are "handbook" values employed for estimating system losses. For a globe valve in the wide-open position, a $k$ factor of 10 is shown. But reasonably good design can reduce this to 3.4. Similarly, a wide-open angle valve has a handbook $k$ factor of 4, but a well-designed angle valve even without special low-loss construction may drop this value to 1.5. An angle valve designed and built for extremely low fluid-friction losses can lower the $k$ factor to only 0.85.

So again it boils down to a matter of economic balance. While using the handbook values given in the piping report for normal estimating purposes, the energy-systems engineer always has a trick up his sleeve: the special low-loss valves that can be incorporated in his system, should pumping-power gains justify their added cost.

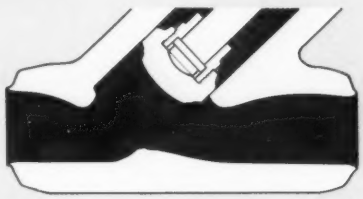
There is, of course, another element here: the handbook values cover "average conditions of cleanliness". These apply to service life of normal systems. Where special low-loss valves are warranted, it is only sensible to keep the entire system as clean as possible to minimize *all* losses. Therefore, special low $k$ factors given here for specific valves presume a high degree of cleanliness throughout the operating life of the valve.

In addition to globe and angle valves, check valves have been subjected to much study in an effort to reduce energy losses. Internal-design considerations for the low-loss check valves parallel those we have already mentioned for globe and angle valves.



**Standard globe valve**

Sharp corners and abrupt flow-pattern changes in control valves produce high losses



**Low-loss globe valve**

Contoured waterways keep fluid-friction loss at minimum with valve at wide-open position

## Some valve terms you'll need to know

**WOG and SP**
These letters are usually cast on valve bodies to show the pressure rating for which the valve is designed. WOG stands for "water, oil, gas" and applies to relatively cool liquid or gas service. SP stands for "steam pressure" and is used to designate high-temperature steam service. In each case, number following letter symbol is the maximum nonshock operating pressure in psi at 100 F.

**OS&Y, RS and NRS**
Type of valve-stem screw is indicated by this letter code. OS&Y means "outside screw and yoke". Here, packing is between the stem screw and the valve body—isolating fluid from the screw threads. *RS* and *NRS* signify "rising stem" and "nonrising stem" respectively. If valve stem screws into body, the stem rises when valve is opened. But if stem screws into the disk, stem itself does not move when the valve is opened—only the disk rises.

**Screwed ends**
Screwed-end valves usually have American Standard tapered thread, female type, unless otherwise specified.

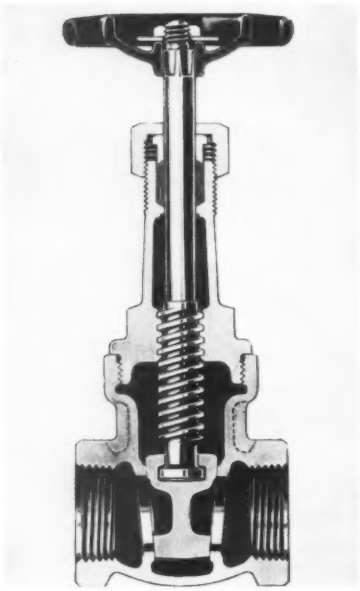
**Solder-joint ends**
In this construction, sockets are formed at each end of the valve. Pipe is soldered into them. This valve end is common for l-p l-t plumbing and heating applications.

**Butt-weld ends**
Lips are formed on the ends of the valve to exactly butt against connecting piping in the system. Lip ends of both pipe and valve are machined, forming an inside groove to accommodate a backup ring for welding.

**Socket-weld ends**
In smaller pipe sizes it isn't practical to insert the backup ring employed in butt welding. So a socket is formed in the ends of the valve. Pipe is fitted into the socket and the weld made around the valve end. Special care is needed in assembly to make sure that some clearance exists to take care of expansion during welding.

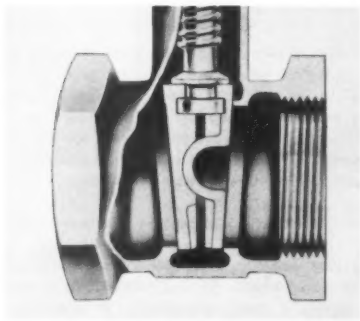
**Flanged ends**
For large valves and high temperatures and pressures, circular flanges are formed integrally with the valve body and drilled to provide for bolting. Many flange-face types are available for various service conditions.

# VALVE FLUID-END is selected after carefully



**Single-wedge gate**

Wedge homes between angled seats, cutting off flow. Stem rises with wedge



**Double-wedge gate**

Last downward turn spreads split wedges, seals each half independently

**Each valve gets its name and distinctive features from design of the fluid-handling end. These ends take many shapes depending on their function. First step in assuring satisfactory life is to employ the design best suited for each particular job. On this and the next nine pages, principal fluid ends are fully described and related to application and service. Bonnet types are largely independent of fluid-end design, depending instead on operating pressures and temperatures, so these are shown separately, below.**

## Gates handle on-off service

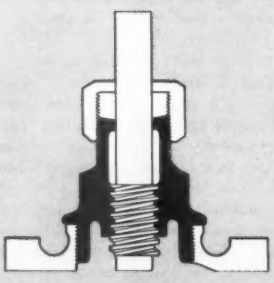
Gate valves have for many years been the old standby for on-off fluid control. They are inherently tight-sealing and impose minimum fluid losses in any system. They are not, however, satisfactory for modulating-control purposes—gates and seats erode rapidly in any position except wide open and tight shut. There is also difficulty from an operating viewpoint: flow rate does not change evenly with valve-stem travel. Most of flow change occurs near shutoff at relatively high velocity, aggravating disk and seat wear, causing eventual inability to get tight shutoff.

Two basic disk types exist for gate valves. In one case a single, solid wedge-shaped disk seats in two similarly angled port openings. Downward force exerted on this disk jams it between polished seats for a tight seal. In the second case, double-wedge gates get their tight seating force from interaction between disk halves and the valve stem. On closing, these disks are lowered by the valve stem, but remain free to move slightly with respect to each other. When they get to a seating position they are still loose. Additional downward turning of the valve stem at this point forces each half individually against its seat. With this design the two seat faces and the disk need not be at exactly the same angle for effective sealing.

Gate-valve stems also come in two arrangements. In the more common, stem screws into the bonnet, rises with the disk and handwheel when the valve is opened. All three parts maintain their same relative positions open or closed. This is called a rising-stem (*RS*) valve. But where available space is limited, stem can be threaded into the disk. When the nonrising-stem (*NRS*) valve is opened, disk rises on the stem threads; stem and handwheel remain at the same elevation.

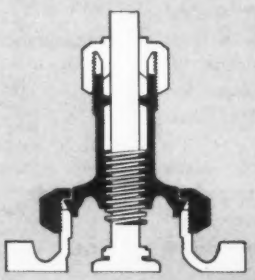
In gate valves the parts taking the beating are disks and seats. Where erosion due to velocity or solids is a problem, disk and seat material must be carefully chosen for high surface hardness. Where service dictates seats of different material from the valve body, replaceable seats and disk cut costs. If seats were integral, whole valve body would have to be repaired.

## Valve bonnet designs meet operating conditions that vary



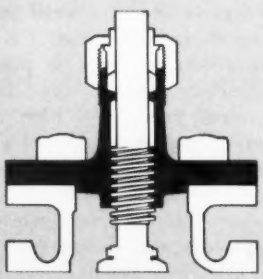
**Screwed**

Usual construction for light- and medium-duty, screwed bonnets cost least



**Union**

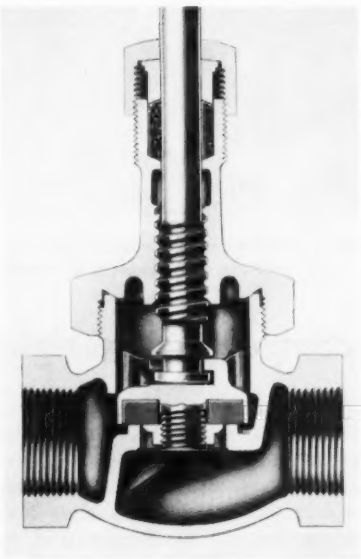
Flat sealing faces assure tightness here —no chance to weep through threads



**Flanged**

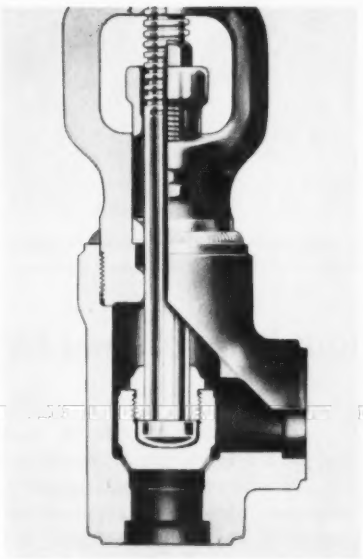
For higher pressures, bolted flanges ease disassembly—no threads to bind up

# analyzing demands of the job at hand



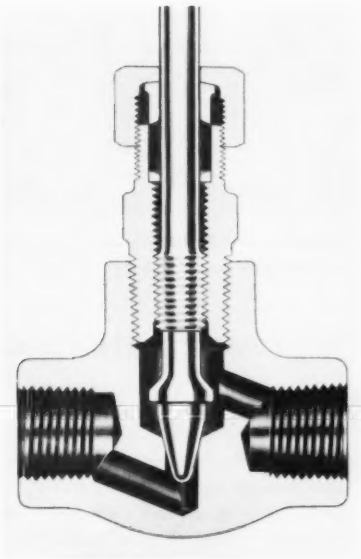
**Standard globe**

Replaceable composition plug takes wear, saves integral seat, prolongs life



**Angle globe**

Angle valve helps cut fluid-friction losses—body replaces one 90-deg elbow



**Needle**

Acute conical shape of this valve's plug gives fine control for long stem travel

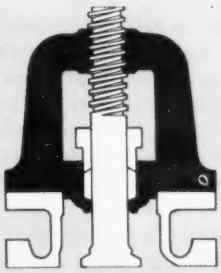
## Globes take care of modulating control

Globe valves are specifically designed to modulate fluid flow. Basic design calls for a plug seating on or in a shaped hole in the valve body. Flow through this orifice is usually at 90 deg to system flow, so fluid losses may be high. Plug and seat shapes in globe valves can be varied to alter flow-control characteristics. Needle valves are an extreme example. Here flow change is very slow since the annular opening between needle and seat does not change rapidly with stem rise. At the other extreme, common globe valves with flat seats open more quickly with stem rise. Bevel seats are in between.

Fluid control necessarily involves energy degradation, so velocity in globe valves can become extremely high, especially when flow is low and the valve is approaching shutoff. Where operating temperatures permit, globe-valve plugs can be faced with a relatively soft-composition material. Dirt and scale then embed in the composition and protect the seat from excessive wear. Composition plug is easy to replace when worn out.

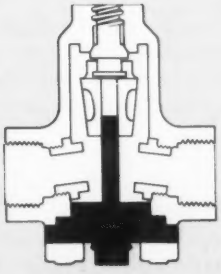
At higher temperatures, both plug and seat must be metallic. Here special hard materials will pay off. Plug can also be designed to rotate freely, independent of the valve stem. Then, on closing, it pushes into the seat, does not turn and become scored by entrapped particles.

## from mild to highest pressures and temperatures



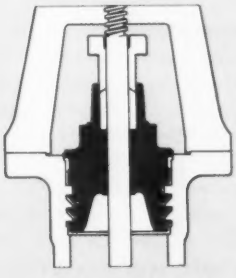
**Outside screw and yoke**

Stem screw threads are isolated from flow by this valve's outside-yoke design



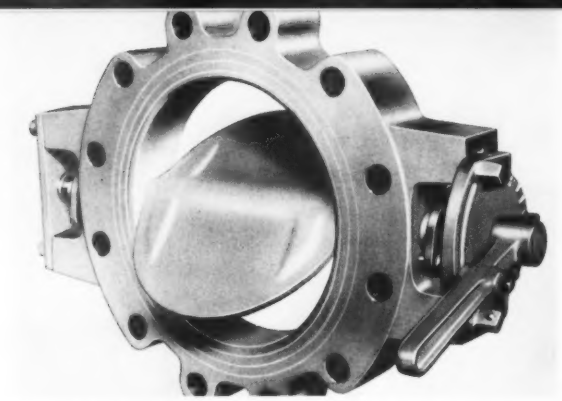
**Bonnetless**

No conventional bonnet here; parts are removed through bottom plate or plug

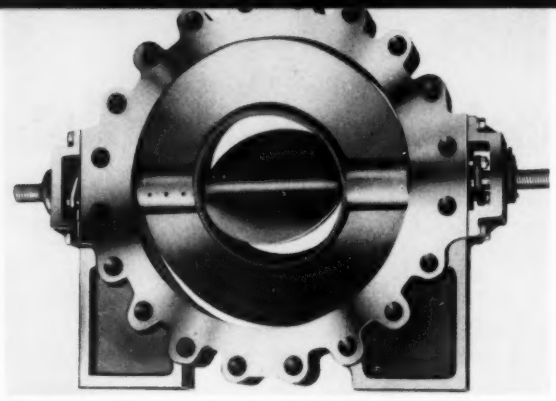


**Breachlock**

Where pressures are very high, breachlocks are strong, can be seal-welded



**STANDARD BUTTERFLY VALVE** saves space. It need not be independently supported and almost any actuator can be used



**DOUBLE-PORTED VALVE** increases control range beyond usual 10-to-1 turndown by using only the small port at low flows

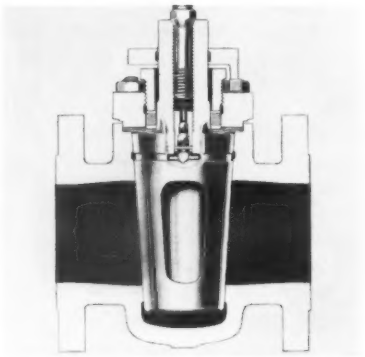
## Improved butterfly designs help fill need for a compact, lightweight

Butterfly valves are certainly not new, but in the last several years they have been receiving increased interest as final control elements. As a basic valve type they offer many advantages to the systems designer; recent improvements have broadened their fields of application.

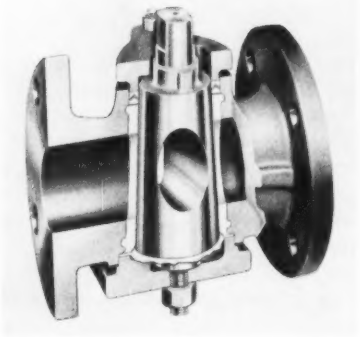
If tight sealing is part of the job to be done, butterfly valves are frequently lined with a resilient material so the rotating disk seats tightly when closed. Where high temperatures preclude the use of this resilient lining, the disk itself can be provided with a piston ring to minimize leakage. Light weight of butterfly valves often permits their use in piping systems without separate support.

The butterfly is essentially an equal-percentage valve type in the normal control range. Any change in valve travel results in an equal-percentage change in flow. From the viewpoint of change in open-valve area only, this equal-percentage statement would not seem justified. However, approach velocity as well as diverting action of the disk is a function of disk position. Their combined effect, together with change in valve area, produces the equal-percentage characteristic.

Most butterfly designs can turn down to a ratio of about 10 to 1. For good control beyond this point a small port can be built into the larger disk. Small port then works



**LUBRICATED VALVE'S** tapered plug is lifted by lube pressure, avoids jamming



**RESILIENT LINER** in this unlubricated tapered-plug valve seals tight at shutoff

**MULTIPORT PLUG VALVE** selectively directs flow into one of several systems

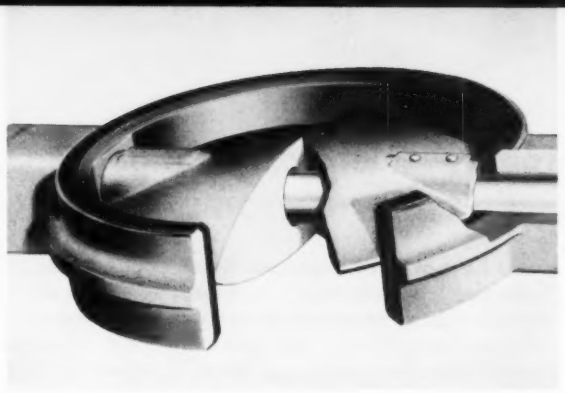
## Plug valves now bid for clear-liquid jobs . . .

Crude age-worn wooden plug valves, oldest members of the valve family, have been dug up in ancient ruins. Today the plug valve retains an important niche in energy systems, where its main application is handling fluid-solid mixtures. Benefit: foreign material which might prevent full closure of a gate valve is scraped right off the plug as valve closes.

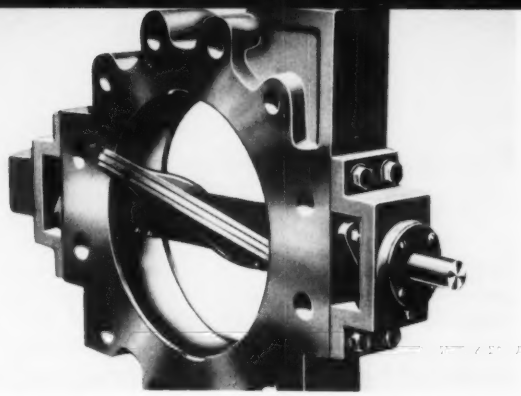
In recent years plug valves have broken out of their primary application area and find increasing favor in clear-liquid systems where space is a consideration. Here they must compete with the standard gate-valve designs.

Plugs can be cylindrical or tapered, lubricated or nonlubricated, depending on service and frequency of operation. Lubricated tapered plugs seat tightly, but if you try to operate them dry, they can jam in the tapered seat and will score badly if forced. So they are usually provided with a separate lube system which goes into action before you try to open or close the valve. Grease is forced around the plug as well as beneath it, raising it slightly, lubricating it and permitting easy operation.

Cylindrical and tapered plug valves can also be supported by an inert resilient liner. Then there is no need to



**BUTTERFLY'S RESILIENT LINER** provides tight shutoff at low temperatures. Valve then serves for both on-off and control



**PISTON RING** in valve disk minimizes leakage in closed position where very high temperatures preclude a resilient liner

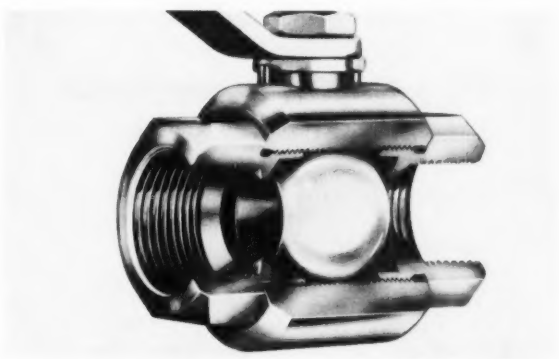
## control and shutoff valve

independently at low flows, increasing the turndown ratio.

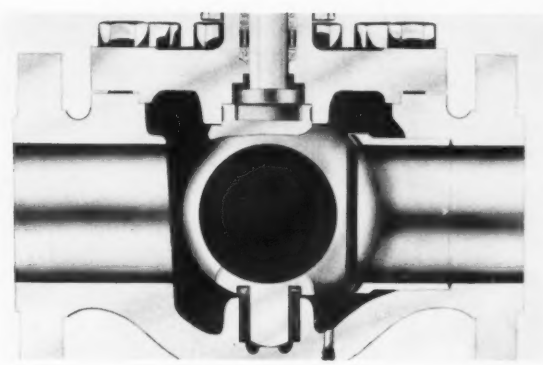
Maximum valve-stem travel is somewhat less than 90 deg—usually 60 to 70, depending on structural design of stem and disk. So travel can be short from wide-open to tight-shut, simplifying actuator design.

In selecting butterfly-valve actuators, watch out for wide variations in required control-arm torque from wide open to dead shutoff. *And*, this torque varies depending on which way you are going—opening or closing the valve. Unbalanced fluid torque tends to close a butterfly valve; static torque (the friction of the valve mechanism—bearings, packing and seals) can be in either direction. Both of these forces are proportional to disk position and pressure drop. So operating torque needed to open a butterfly valve is the sum of fluid and static torques; torque needed to close is the difference between the two. Since both unbalanced fluid and static torques are proportional to pressure drop, disk-shaft diameter must increase to meet increased pressure drops. At all intermediate valve positions, thrust load on the upstream wing of the disk is greater than the load on the downstream wing.

Butterfly valves will undoubtedly pick up an even larger share of control-valve assignments as more and more engineers become aware of their special advantages.



**BALL VALVE'S** rotating element is squeezed between two adjustable resilient seats. Seats can be taken up, prolonging life



**ECCENTRIC BALL VALVE** needs no lubricant or resilient liner to get tight closure in metal-to-metal seat arrangement

## . . . as recent ball-valve version gains favor

lubricate the valve before operation to prevent plug scoring; resilient liner does the job. Multiport plug valves may be positioned to permit flow in any one of several directions, routing flow through several systems. Usually the incoming flow is directed to the bottom of the plug, the internal opening turning 90 deg through the port.

Although ball valves are comparatively new—they've been around for about ten years—they are now catching on rapidly. Essentially, a ball valve is an adaptation of the plug, retaining all the plug-valve benefits while adding a few of its own. Instead of a conical plug, these valves use a confined sphere. Squeezing this ball between two resilient seats will shut the valve off tight. Most designs are adjustable so life can be extended by taking up seat wear as it occurs. As is the case with plug valves, ball valves go from wide open to fully closed merely by being turned 90 deg. This simplifies some types of automatic actuation and provides for quick operation.

Fluid losses in both plug and ball valves are inherently low, since port through the valve is large and flow direction does not change—except in a multiport valve where loss is no greater than for an elbow fitting.

# Check valves protect equipment from reverse-flow damage

Flow reversal in fluid-handling systems can be caused by accidental equipment stoppage or automatic fail-safe devices. This reversal must be promptly and effectively halted, or tanks overflow, rotating equipment overspeeds and you're left with local flooding and damaged machinery.

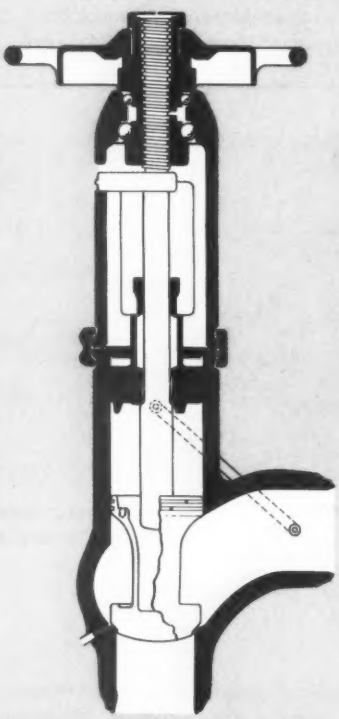
Open in one flow direction, closed in the other, check or nonreturn valves prevent flow reversal. In design they range from simple, inexpensive swing-disk or flap valves to hydraulically contoured tilting-disk valves for high pressures and high temperatures. "Stop-check" valves do double duty; they operate as check valves, but also can be turned down by hand or motor to assure tight closing.

All check valves used in energy systems fall into two basic categories, piston and disk. Piston types, including ball and stop-check valves, have relatively high internal losses because of flow-direction change. But they do seal tight. Some designs, however, depend on a free-riding piston which can hang up if clogged with dirt or scale after long, continuous operation. In other designs, a bleed line back of the piston helps seat the valve by using downstream pressure to start it moving.

Tilting-disk check valves, including swing-disk and flap types, keep fluid losses low with almost straight-through flow. They close dependably with slightest flow reversal or even at zero flow. But a tight seal is less sure, especially if valve happens to close against a foreign particle.

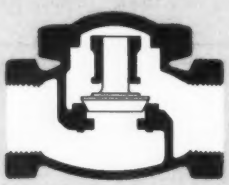
Some recent high-pressure installations have two check valves in series. A piston type shuts off tight, followed by a disk type to assure at least partial closure and preclude high-volume flow reversal through the system.

## All nonreturn valves can be broadly classified as piston or disk types



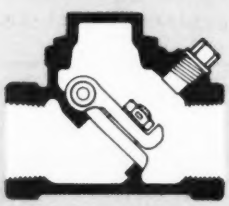
**Stop check**

Hand- or motor-operated follower controls check action positively. After flow stops, follower is lowered into place, making sure the piston is fully, tightly seated. Added bonus: this design can double in brass as a stop valve—actually two valves in one



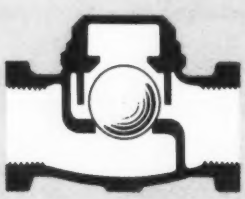
**Piston**

For high-pressure-temperature use, piston valves assure tight shutoff with any flow reversal. Bleed line from downstream side to area behind piston boosts closing force. Result: less danger of hangup after valve has been operating open for a long time



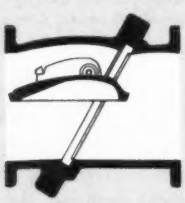
**Swing disk**

Fluid-friction loss through a simple swing-disk check valve is relatively low. Replaceable composition washers fitted on disk take most of the wear, stretching life of the seat. A loose-fitting pin hinge makes sure this type closes as flow diminishes to zero



**Ball**

Free-floating ball in this check valve never seats twice in exactly the same way. So each seating presents a new ball surface, cutting wear and prolonging valve life. Seats are usually replaceable—ball and seats can be removed without opening the pipe



**Tilting disk**

Contoured design in combination with straight-through flow path holds the friction loss to a minimum in this heavy-duty tilting-disk check valve. Disk "floats" on full flow—starts to close with flow reduction. This design feature helps prevent valve slamming

# Safety and relief valves guard against overpressure

Safety and relief valves come in a variety of designs to prevent equipment damage by relieving accidental overpressure. This excess pressure may vent to atmosphere or discharge to some low-pressure point in the system. Most safety and relief valves are spring-loaded to operate at a set pressure but weighted levers or a combination of levers and springs may also provide the load. In any case, valve loading is adjustable so a fine degree of control can be field set after installation.

Confused nomenclature is a problem in this area. The names "safety" and "relief" are frequently used interchangeably—but they shouldn't be. Actually, there is a real and important difference between these two types, which their names do reflect if used properly.

*Safety valves* are for the compressible fluids—steam and other gases. This compressibility demands quick overpressure relief. So safety valves have *pop* seats and plugs which open rapidly on overpressure, relieving at full flow. They may discharge steam to atmosphere or direct a costly or toxic gas back to the system.

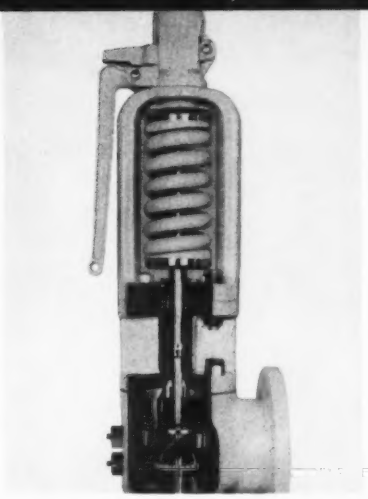
*Relief valves* handle noncompressible fluids—liquids such as water and oil. Immediate full-flow discharge is not needed since a very small flow significantly reduces overpressure. So plug and seat open and close slowly, discharging back to some low-pressure point in the system to conserve the liquid.

Box at right shows why pop-safety valves operate differently from relief valves. In the relief valve, plug area exposed to the overpressure stays constant whether valve is open or closed. So operation is gradual, and degree the valve is open becomes a function of differential pressure. Safety valves, however, have a variable effective plug area. At the instant of opening, the plug area increases, boosting the total opening force against the constant spring load. Actual opening from zero to full flow is fast; same effect pops the safety valve shut when pressure falls below blowdown level.

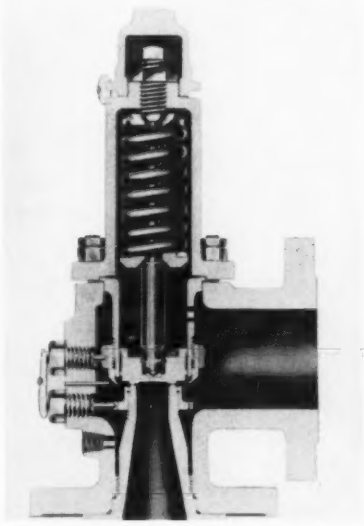
External operating levers can be installed with either valve; they are required wherever frequent testing is a must. ASME—American Society of Mechanical Engineers—Codes covering installation and operation of safety valves are accepted by most regulatory bodies, Federal, state and local.

Safety and relief valves should always be connected directly to the equipment they protect—no intermediate valves and shortest-possible piping. If you're using outlet piping, keep it short, too, with minimum friction drop to prevent chattering when the valve is open. Valve setting must take into account any backpressure. Example: if a safety valve is to open at 100 psig against a constant backpressure of 10 psig, set it at 90 psig to be sure it actually opens when pressure reaches 100.

Safety valves have relieving pressures marked on them. Capacity rating marked on the valve depends on blowdown—difference between relieving and closing pressures—and usually runs about 4%. If you need to adjust blowdown because of a change in pressure setting, do not decrease it too much. Too small a blowdown frequently causes the valve to "simmer"—fail to open sharply.



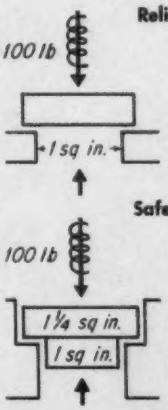
**SAFETY VALVE** for high pressures has external lever as an operating check



**RELIEF-VALVE** spring loading can be adjusted to open at any needed pressure

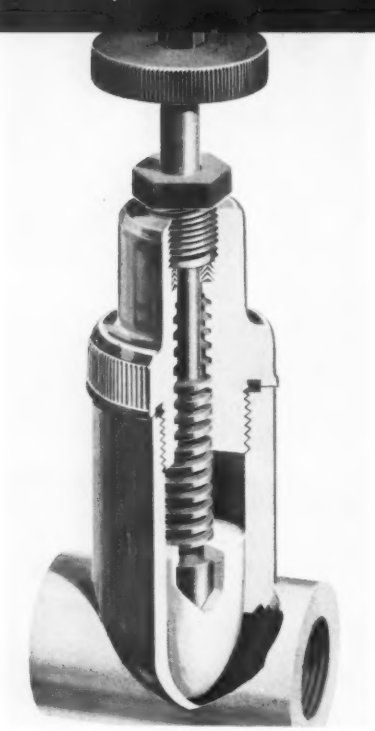
### Safety valves pop while relief type opens slowly

Sketches and pressure sequences below show why a *safety* valve opens quickly at set pressure for immediate full-flow discharge. In comparison, a *relief* valve opens and closes slowly, allowing full flow only after significant overpressure builds up in system



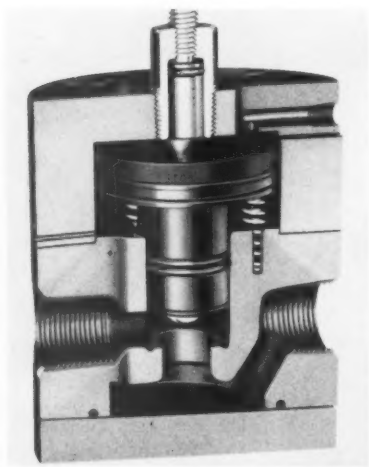

**Relief**
90 psi × 1 sq in. = 90 lb up vs 100 lb down
100 psi × 1 sq in. = 100 lb up vs 100 lb down
(valve starts to open)
110 psi × 1 sq in. = 110 lb up vs 110 lb down
120 psi × 1 sq in. = 120 lb up vs 120 lb down
(valve is fully open with full flow)
120 psi is a 20% overpressure

**Safety**
90 psi × 1 sq in. = 90 lb up vs 100 lb down
100 psi × 1 sq in. = 100 lb up vs 100 lb down
(valve starts to open)
100 psi × 1¼ sq in. = 125 lb up vs 100 lb down
(valve is fully open with full flow)
80 psi × 1¼ sq in. = 100 lb up vs 100 lb down
(valve starts to close)
80 psi × 1 sq in. = 80 lb up vs 100 lb down
(valve is fully closed)



**ALL-PLASTIC GLOBE VALVE** cuts cost, often ups service life on corrosive fluids

**BALL VALVE** for on-off operation is designed in a range of plastic materials



**CONTROL VALVE** with solid-plastic liquid end uses seal to protect mechanism

# Plastics combat corrosion at moderate pressures, temperatures

Developments in plastic valves follow closely on the heels of similar activity in the pipe-and-fitting area. First plastic valves were small, but many types can now be purchased in sizes through ten inches, some even larger. Choice of plastics, formerly quite limited, is now wide enough to meet most needs. PVC (polyvinyl chloride) seems to be one of the most popular materials; its application range is wide. But many others—Saran (polyvinylidene chloride) is an example—are now used where specific operating conditions warrant.

Most current plastic materials are "thermoplastic", tending to soften and lose strength with increased temperature; therefore pressure-temperature limitations on plastic valves are so far rather stringent. Usual: about 150 psig at 150 F. But new plastic materials keep on coming out of the research lab. Many of them hold promise of raising these limits, broadening their field of use in energy systems. Increase in number of plastic-valve types and sizes on the market will also widen range of application.

Right now, plastic valves compete in two broad areas: (1) In highly corrosive environments—weak acids, for example—where costly high-alloy-steel valves have previously been common, plastic valves cut costs and frequently stretch operating life. (2) In mildly corrosive low-pressure cooling systems—sea water is a case in point—where the high cost of heavier stainless and alloy-steel valves could never really be justified, plastics are superior to many common valve materials at comparable first cost.

In addition to the valve types pictured, needle, ball check, foot, 3-way and cock valves are available in plastic. All are produced by injection molding from one of the popular corrosion-resistant plastics.

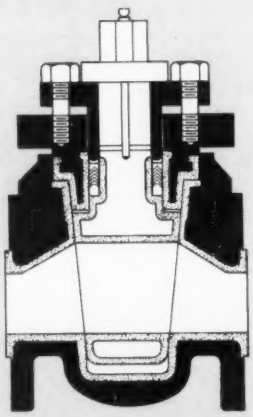
Valves can be had with any one of several end connections. In small sizes, screwed ends are common; flanges are usual in the larger valves. And socket-weld joints are available, "welded" with a solvent which seals the joint like a normal steel-pipe socket weld.

When selecting plastic valves, make sure *all* parts in contact with the fluid handled are plastic or covered with plastic. Nonplastic parts may be essential for structural and operating reasons, *but* they must be adequately protected or sealed. Otherwise you may lose all benefit of corrosion-resistant construction.

## Plastic-lined valves withstand higher pressure

**Where system operating pressures and temperatures exceed thermoplastic limits, but corrosion resistance is a must, plastic-lined steel valves may apply. Plastic withstands corrosion, steel takes the pressure—and temperatures can go up some as long as the plastic liner doesn't tend to flow.**

**Before it's lined, inside of steel valve is knurled to give lateral support for the plastic. In small sizes, plug may be solid plastic; large sizes often use plastic-covered steel. Again, all parts that contact corrosive fluid must be completely protected.**



# Balanced valves ease control-stem loads on actuators

Wherever actuation has to maintain fine flow control, valve-stem loading must be kept down. Usually the forces available to move the valve stem are limited from an economic viewpoint; also, from a practical angle, actuating devices can't be too large. Here, then, balanced valves are a must.

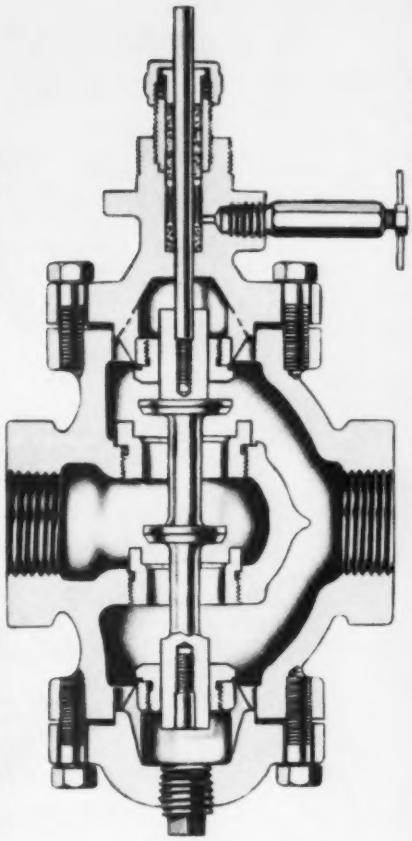
Typical balanced valve, top right, divides flow in half through two control ports. Flow velocity tends to open one port (the one in the direction of valve travel) and close the other (in direction opposite to valve travel). So you approach fluid balance in any valve position from tight closed to wide open.

Port areas can be varied for finer balance. In our typical valve, upper port has slightly larger diameter than the lower one. This cuts thrust loading on valve stem and hence on actuator, gives the ultimate in valve-stem balance.

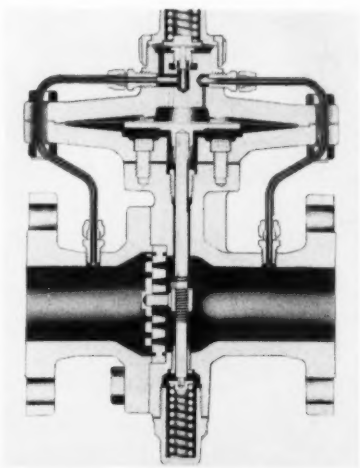
Rate of flow change should jibe with stem travel produced by the actuator. Several plug designs handle this chore, box, below right. Plug *A* is essentially a flat disk. It goes from tight shutoff to wide open with very slight stem travel. Skirts beneath the plug prevent lateral movement, guiding plug and stem when valve is open. Plugs *B* and *C* are examples of equal-percentage designs—flow rate changes at the same percentage traveled by the valve stem. Flow control is sensitive because of stem's relatively long movement from shutoff to wide open. As valve opens, two body bushings guide the stem.

Sliding-port valve, below left, represents another approach to low stem loading. Flow velocity exerts no direct fluid thrust—neither up nor down. It merely pushes the sliding member against its stationary seat, increasing friction force slightly. When this valve is tight shut, fluid forces tend to seal the valve tight rather than open it. Here, too, ports in sliding and stationary seats can be cut to vary rate of flow change with valve-stem travel.

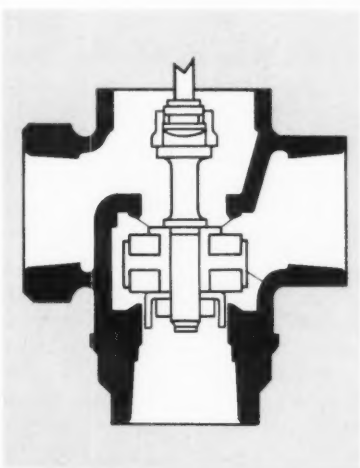
A variation of balanced-valve construction is the mixing valve, below. This one shuts off bottom inlet when plug is fully down; with plug fully raised, side-inlet flow cuts out. Any intermediate position proportions the two inlet flows to meet operating needs. Remember, this mixing valve is never "off"—both side- and bottom-inlet flows cannot be stopped completely at the same time.



**TWO VALVE PORTS** with opposed flows approach fluid balance in any position

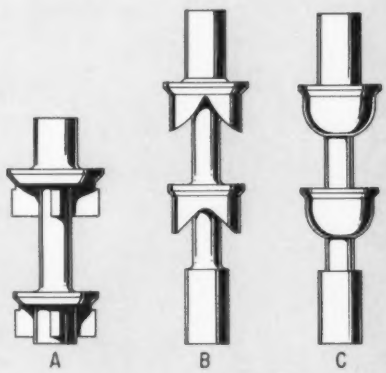


**SLIDING PORTS** eliminate fluid thrust—only friction of sliding seats to overcome



**MIXING VALVE** regulates proportion of two inflows to produce controlled output

## Plug designs alter flow rate with valve-stem travel

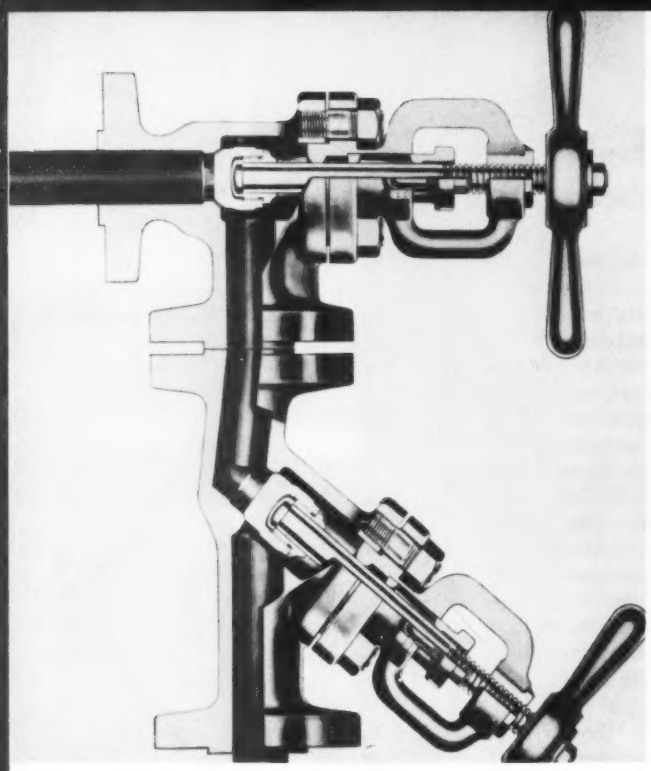



**A**—Quick-opening plug, skirt guided, gives full flow with minimum travel

**B**—Equal-percentage V-port plug directly relates flow change to stem travel

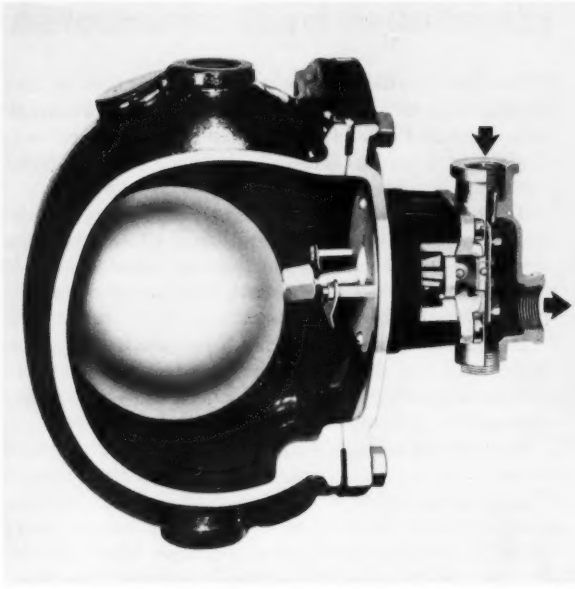
**C**—Equal-percentage contoured plug is guided top and bottom by valve stem

# Here are some special valve



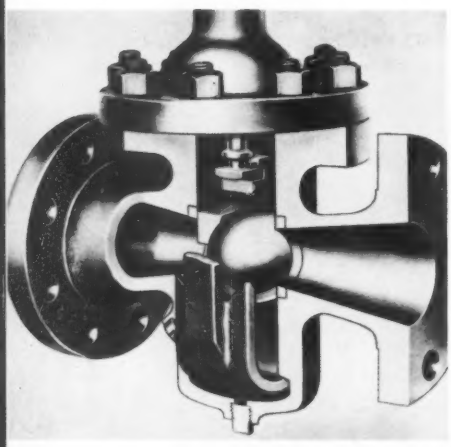
**Blowdown**

Double-blowdown-valve arrangement uses one valve exclusively for tight shutoff while the other takes throttling wear



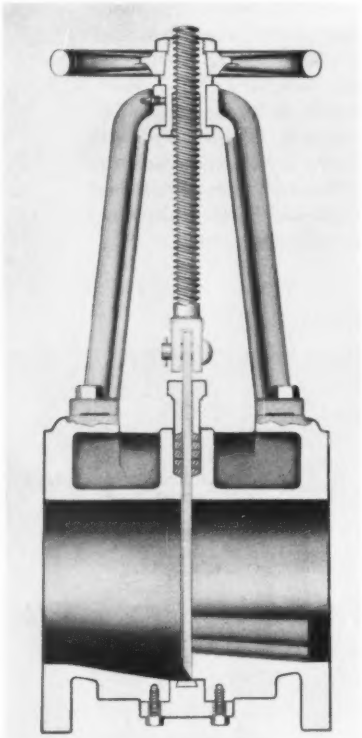
**Float**

Liquid level in separate tank or receiver controls float position. Float opens and closes valve to hold preset tank level



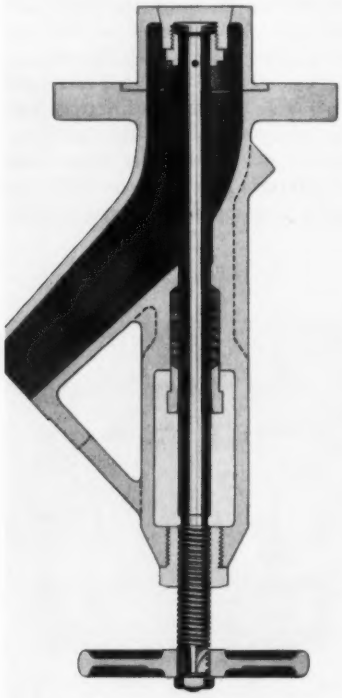
**Ball throttle**

Cage lifts ball which rolls away from seat. Crescent shape minimizes erosion



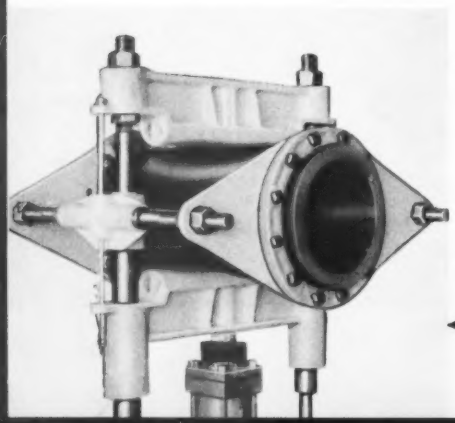
**Paper stock**

Knife edge on this gate-valve adaptation cuts through pulp to seal tight



**Bottom drain**

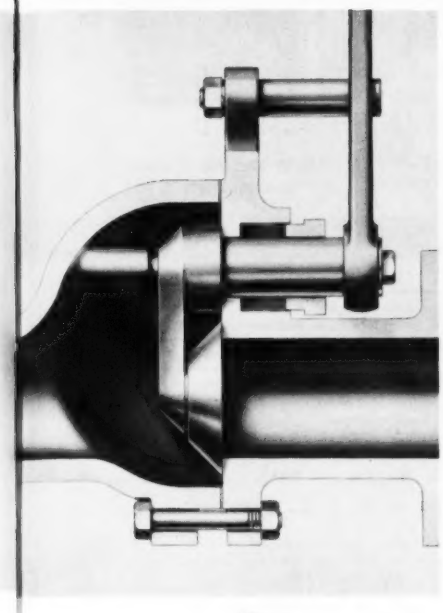
Opening extends plug into tank. Fluid force works toward positive closure



**Pinch**

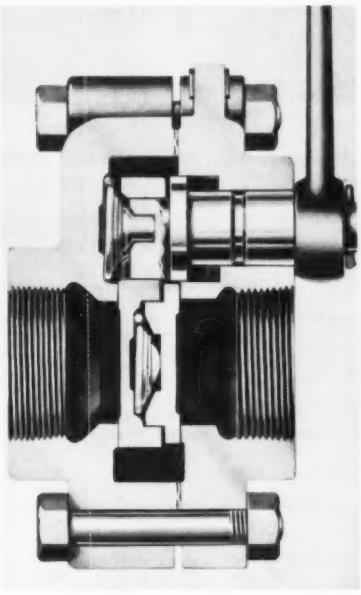
For use with flexible hose, pinch valve is handwheel or cylinder operated

# designs tailored to fit specific fluid-handling jobs



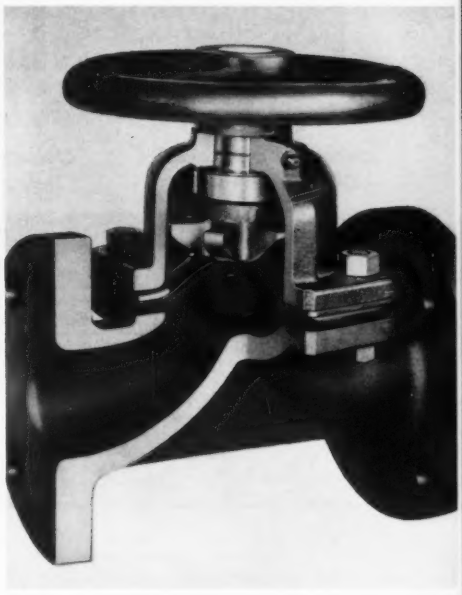
**Slurry**

Lever-operated knife-edge disk excludes solids which might hinder tight closing



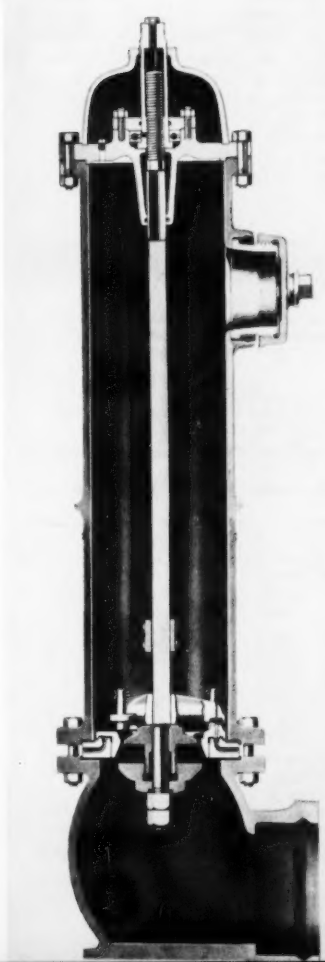
**Quick-opening**

Lever arm opens valve fast. Disk halves are spring loaded to shut off tight

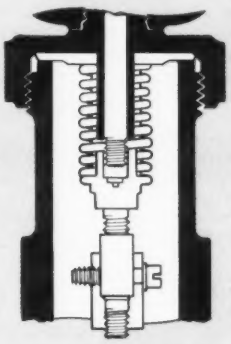


**Diaphragm**

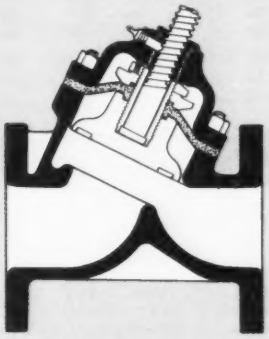
Replaceable diaphragm acts as plug and stem seal. All-plastic is popular



## Positive valve-stem seals prevent leakage



**Bellows seal**



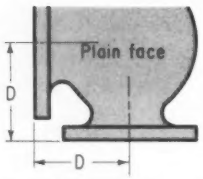
**Diaphragm seal**

These special valve-stem sealing arrangements up reliability. They positively exclude fluid handled from the operating mechanism and prevent outside leakage. Flexible bellows, left, expands and contracts with stem travel; ends are fastened tightly to stem and bonnet. Ductile materials assure long bellows life. Diaphragm construction, right, uses a reinforced flexible-plastic seal. Fluid-tight diaphragm fastens to both stem and bonnet, flexes with valve operation. Of course, diaphragm material must be carefully selected to permit long and successful service with repeated flexing.

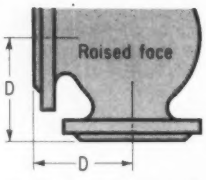
← **Fire hydrant**

When valve is closed, drains at underground plug level prevent freezing

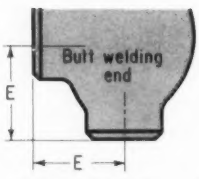
# Do it right! Use American Standards Association valve



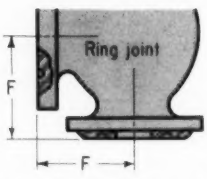

Class-125 cast-iron and 150-lb stainless steel




Class-250 cast-iron and 150-lb and 300-lb steel




150-lb and 300-lb steel




150-lb and 300-lb steel

## Standard dimensions (inches) for Class-125 cast-iron and 150-lb steel valves

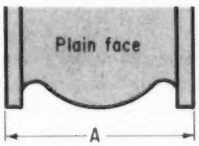
| Nominal valve size | Class-125 cast iron: Flanged end—plain face: Gate: Solid wedge A | Gate: Double disk A | Plug: Short pattern A | Plug: Regular A | Plug: Venturi A | Globe and lift check A | Angle and lift check D | Swing check A | Control A | 150-lb steel: Flanged end (1/16-in. raised face) and welding end: Gate: Solid wedge A | Gate: Double disk A | Gate: Solid wedge B | Gate: Double disk B | Plug: Short pattern A | Plug: Regular A | Plug: Venturi A | Plug: Round port full bore A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/4 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 4 | 4 | 4 | 4 | ---- | ---- | ---- | ---- |
| 3/8 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 4 | 4 | 4 | 4 | ---- | ---- | ---- | ---- |
| 1/2 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 4 1/4 | 4 1/4 | 4 1/4 | 4 1/4 | ---- | ---- | ---- | ---- |
| 3/4 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 4 3/8 | 4 5/8 | 4 3/8 | 4 5/8 | ---- | ---- | ---- | ---- |
| 1 | ---- | ---- | 5 1/2 | 5 1/2 | ---- | ---- | ---- | ---- | 7 1/4 | 5 | 5 | 5 | 5 | 5 1/2 | ---- | ---- | 7 |
| 1 1/4 | ---- | ---- | ---- | 6 1/2 | ---- | ---- | ---- | ---- | ---- | 5 1/2 | 5 1/2 | 5 1/2 | 5 1/2 | ---- | ---- | ---- | ---- |
| 1 1/2 | ---- | ---- | 6 1/2 | 6 1/2 | ---- | ---- | ---- | ---- | 8 3/4 | 6 1/2 | 6 1/2 | 6 1/2 | 6 1/2 | 6 1/2 | ---- | ---- | 8 3/4 |
| 2 | 7 | 7 | 7 | 7 1/2 | ---- | 8 | 4 | 8 | 10 | 7 | 7 | 8 1/2 | 8 1/2 | 7 | ---- | ---- | 10 1/2 |
| 2 1/2 | 7 1/2 | 7 1/2 | 7 1/2 | 8 1/4 | ---- | 8 1/2 | 4 1/4 | 8 1/2 | 10 7/8 | 7 1/2 | 7 1/2 | 9 1/2 | 9 1/2 | 7 1/2 | ---- | ---- | 11 3/4 |
| 3 | 8 | 8 | 8 | 9 | ---- | 9 1/2 | 4 3/4 | 9 1/2 | 11 3/4 | 8 | 8 | 11 1/8 | 11 1/8 | 8 | ---- | ---- | 13 1/2 |
| 3 1/2 | 8 1/2 | 8 1/2 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 4 | 9 | 9 | 9 | 9 | ---- | 11 1/2 | 5 3/4 | 11 1/2 | 13 7/8 | 9 | 9 | 12 | 12 | 9 | ---- | ---- | 17 |
| 5 | 10 | 10 | 10 | 14 | ---- | 13 | 6 1/2 | 13 | ---- | 10 | 10 | 15 | 15 | ---- | ---- | ---- | ---- |
| 6 | 10 1/2 | 10 1/2 | 10 1/2 | 15 1/2 | 15 1/2 | 14 | 7 | 14 | 17 3/4 | 10 1/2 | 10 1/2 | 15 7/8 | 15 7/8 | 10 1/2 | 15 1/2 | ---- | 21 |
| 8 | 11 1/2 | 11 1/2 | 11 1/2 | 18 | 18 | 19 1/2 | 9 3/4 | 19 1/2 | 21 3/8 | 11 1/2 | 11 1/2 | 16 1/2 | 16 1/2 | 11 1/2 | 18 | ---- | 25 |
| 10 | 13 | 13 | 13 | 21 | 21 | 24 1/2 | 12 1/4 | 24 1/2 | ---- | 13 | 13 | 18 | 18 | 13 | 21 | 21 | 31 |
| 12 | 14 | 14 | 14 | 24 | 24 | 27 1/2 | 13 3/4 | 27 1/2 | ---- | 14 | 14 | 19 3/4 | 19 3/4 | 14 | 24 | 24 | 36 |
| 14 | 15 | ---- | ---- | 27 | 27 | 31 | 15 1/2 | 31 | ---- | 15 | 15 | 22 1/2 | 22 1/2 | ---- | ---- | 27 | ---- |
| 16 | 16 | ---- | ---- | 30 | 30 | 36 | 18 | ---- | ---- | 16 | 16 | 24 | 24 | ---- | ---- | 30 | ---- |
| 18 | 17 | ---- | ---- | 34 | 34 | ---- | ---- | ---- | ---- | 17 | 17 | 26 | 26 | ---- | ---- | 34 | ---- |
| 20 | 18 | ---- | ---- | 36 | 36 | ---- | ---- | ---- | ---- | 18 | 18 | 28 | 28 | ---- | ---- | 36 | ---- |
| 24 | 20 | ---- | ---- | ---- | 42 | ---- | ---- | ---- | ---- | 20 | 20 | 32 | 32 | ---- | ---- | 42 | ---- |
| 30 | ---- | ---- | ---- | ---- | 51 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |

## Standard dimensions (inches) for Class-250 cast-iron and 300-lb steel valves

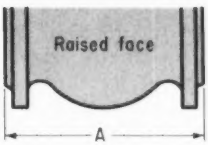
| Nominal valve size | Class-250 cast iron: Flanged end (1/16-in. raised face): Gate: Solid wedge A | Gate: Double disk A | Plug: Short pattern A | Plug: Regular A | Plug: Venturi A | Globe and lift check A | Angle and lift check D | Swing check A | Control A | 300-lb steel: Flanged end (1/16-in. raised face) and welding end: Gate: Solid wedge A&B | Gate: Double disk A&B | Plug: Short pattern A | Plug: Short pattern B | Plug: Regular A | Plug: Venturi A |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1/2 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 7 1/2 | ---- | ---- | ---- | ---- | ---- | ---- |
| 3/4 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 7 5/8 | ---- | ---- | ---- | ---- | ---- | ---- |
| 1 | ---- | ---- | ---- | 6 3/4 | ---- | ---- | ---- | ---- | 7 3/4 | ---- | ---- | 6 1/4 | ---- | ---- | ---- |
| 1 1/4 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 1 1/2 | ---- | ---- | ---- | 7 1/2 | ---- | ---- | ---- | ---- | 9 1/4 | 7 1/2 | 7 1/2 | 7 1/2 | ---- | ---- | ---- |
| 2 | 8 1/2 | 8 1/2 | 7 1/4 | 8 1/2 | ---- | 10 1/2 | 5 1/4 | 10 1/2 | 10 1/2 | 8 1/2 | 8 1/2 | 8 1/2 | 10 1/2 | ---- | ---- |
| 2 1/2 | 9 1/2 | 9 1/2 | 8 | 9 1/2 | ---- | 11 1/2 | 5 3/4 | 11 1/2 | 11 1/2 | 9 1/2 | 9 1/2 | 9 1/2 | 12 | ---- | ---- |
| 3 | 11 1/8 | 11 1/8 | 9 1/4 | 11 1/8 | ---- | 12 1/2 | 6 1/4 | 12 1/2 | 12 1/2 | 11 1/8 | 11 1/8 | 11 1/8 | 13 | ---- | ---- |
| 3 1/2 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- |
| 4 | 12 | 12 | 10 1/2 | 12 | ---- | 14 | 7 | 14 | 14 1/2 | 12 | 12 | 12 | 14 | ---- | ---- |
| 5 | 15 | 15 | ---- | ---- | ---- | 15 3/4 | 7 7/8 | 15 3/4 | ---- | 15 | 15 | ---- | ---- | ---- | ---- |
| 6 | 15 7/8 | 15 7/8 | ---- | 16 3/4 | 15 7/8 | 17 1/2 | 8 3/4 | 17 1/2 | 18 5/8 | 15 7/8 | 15 7/8 | 15 7/8 | 18 | 15 7/8 | 15 7/8 |
| 8 | 16 1/2 | 16 1/2 | ---- | 19 3/4 | 16 1/2 | 21 | 10 1/2 | 21 | 22 3/8 | 16 1/2 | 16 1/2 | 16 1/2 | 20 1/2 | 19 3/4 | 16 1/2 |
| 10 | 18 | 18 | ---- | 23 1/2 | 18 | 24 1/2 | 12 1/4 | 24 1/2 | ---- | 18 | 18 | 18 | 22 | 22 3/8 | 18 |
| 12 | 19 3/4 | 19 3/4 | ---- | 28 | 19 3/4 | 28 | 14 | 28 | ---- | 19 3/4 | 19 3/4 | 19 3/4 | 25 | ---- | 19 3/4 |

This table is adapted from American Standards Association Standard B16.10-1957. For the complete Standard covering pressure ratings up through 2500-lb steel valves, contact ASA, 10 E 40th St, New York 16, N. Y.

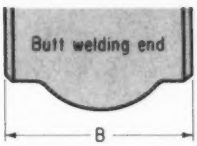
# dimensions when laying out your fluid-handling system



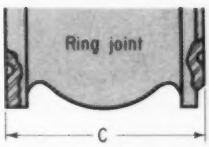

Class-125 cast-iron and 150-lb stainless steel




Class-250 cast-iron and 150-lb and 300-lb steel




150-lb and 300-lb steel




150-lb and 300-lb steel

150-lb steel

| Flanged end (1/16-in. raised face) and welding end | | | | | Flanged end (ring joint) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | Gate | | Plug | | | | | | | |
| Globe and lift check | Angle and lift check | Swing check | Y pattern globe | Control | Solid wedge | Double disk | Short pattern | Regular | Venturi | Round port full bore | Globe and lift check | Angle and lift check | Swing check | Nominal valve size |
| A&B | D&E | A&B | A&B | A | C | C | C | C | C | C | C | F | C | |
| 4 | 2 | 4 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 1/4 |
| 4 | 2 | 4 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 3/8 |
| 4 1/4 | 2 1/4 | 4 1/4 | 5 1/2 | ---- | 4 11/16 | 4 11/16 | ---- | ---- | ---- | ---- | 4 11/16 | 2 15/32 | 4 11/16 | 1/2 |
| 4 3/8 | 2 1/2 | 4 3/8 | 6 | ---- | 5 3/8 | 5 1/8 | ---- | ---- | ---- | ---- | 5 3/8 | 2 3/4 | 5 1/8 | 3/4 |
| 5 | 2 3/4 | 5 | 6 1/2 | 7 1/4 | 5 1/2 | 5 1/2 | 6 | ---- | ---- | 7 1/2 | 5 1/2 | 3 | 5 1/2 | 1 |
| 5 1/2 | 3 | 5 1/2 | 7 1/4 | ---- | 6 | 6 | ---- | ---- | ---- | ---- | 6 | 3 1/4 | 6 | 1 1/4 |
| 6 1/2 | 3 1/4 | 6 1/2 | 8 | 8 3/4 | 7 | 7 | 7 | ---- | ---- | 9 1/4 | 7 | 3 1/2 | 7 | 1 1/2 |
| 8 | 4 | 8 | 9 | 10 | 7 1/2 | 7 1/2 | 7 1/2 | ---- | ---- | 11 | 8 1/2 | 4 1/4 | 8 1/2 | 2 |
| 8 1/2 | 4 1/4 | 8 1/2 | 11 | 10 7/8 | 8 | 8 | 8 | ---- | ---- | 12 1/4 | 9 | 4 1/2 | 9 | 2 1/2 |
| 9 1/2 | 4 3/4 | 9 1/2 | 12 1/2 | 11 3/4 | 8 1/2 | 8 1/2 | 8 1/2 | ---- | ---- | 14 | ---- | 5 | 10 | 3 |
| ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 3 1/2 |
| 11 1/2 | 5 3/4 | 11 1/2 | 14 1/2 | 13 7/8 | 9 1/2 | 9 1/2 | 9 1/2 | ---- | ---- | 17 1/2 | 12 | 6 | 12 | 4 |
| 14 | 7 | 13 | ---- | ---- | 10 1/2 | 10 1/2 | ---- | ---- | ---- | ---- | 14 1/2 | 7 1/4 | 13 1/2 | 5 |
| 16 | 8 | 14 | 18 1/2 | 17 3/4 | 11 | 11 | 11 | 16 | ---- | 21 1/2 | 16 1/2 | 8 1/4 | 14 1/2 | 6 |
| 19 1/2 | 9 3/4 | 19 1/2 | 23 1/2 | 21 3/8 | 12 | 12 | 12 | 18 1/2 | ---- | 25 1/2 | 20 | 10 | 20 | 8 |
| 24 1/2 | 12 1/4 | 24 1/2 | 26 1/2 | ---- | 13 1/2 | 13 1/2 | 13 1/2 | 21 1/2 | 21 1/2 | 31 1/2 | 25 | 12 1/2 | 25 | 10 |
| 27 1/2 | 13 3/4 | 27 1/2 | 30 1/2 | ---- | 14 1/2 | 14 1/2 | 14 1/2 | 24 1/2 | 24 1/2 | 36 1/2 | 28 | 14 | 28 | 12 |
| 31 | 15 1/2 | 31 | ---- | ---- | 15 1/2 | 15 1/2 | ---- | ---- | 27 1/2 | ---- | 31 1/2 | 15 3/4 | 31 1/2 | 14 |
| 36 | 18 | ---- | ---- | ---- | 16 1/2 | 16 1/2 | ---- | ---- | 30 1/2 | ---- | 36 1/2 | 18 1/4 | ---- | 16 |
| ---- | ---- | ---- | ---- | ---- | 17 1/2 | 17 1/2 | ---- | ---- | 34 1/2 | ---- | ---- | ---- | ---- | 18 |
| ---- | ---- | ---- | ---- | ---- | 18 1/2 | 18 1/2 | ---- | ---- | 36 1/2 | ---- | ---- | ---- | ---- | 20 |
| ---- | ---- | ---- | ---- | ---- | 20 1/2 | 20 1/2 | ---- | ---- | 42 1/2 | ---- | ---- | ---- | ---- | 24 |
| ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 30 |

300-lb steel

| Flanged end (1/16-in. raised face) and welding end | | | | | | Flanged end (ring joint) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Plug | | | | | | Gate | | Plug | | | | | | | |
| Venturi | Round port full bore | Globe and lift check | Angle and lift check | Swing check | Control | Solid wedge | Double disk | Short pattern | Regular | Venturi | Round port full bore | Globe and lift check | Angle and lift check | Swing check | Nominal valve size |
| B | A&B | A&B | D&E | A&B | A | C | C | C | C | C | C | C | F | C | |
| ---- | ---- | 6 | 3 | ---- | 7 1/2 | ---- | ---- | ---- | ---- | ---- | ---- | 6 7/16 | 3 7/32 | ---- | 1/2 |
| ---- | ---- | 7 | 3 1/2 | ---- | 7 5/8 | ---- | ---- | ---- | ---- | ---- | ---- | 7 1/2 | 3 3/4 | ---- | 3/4 |
| ---- | 7 1/2 | 8 | 4 | 8 1/2 | 7 3/4 | ---- | ---- | 6 3/4 | ---- | ---- | 8 | 8 1/2 | 4 1/4 | 9 | 1 |
| ---- | ---- | 8 1/2 | 4 1/4 | 9 | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 9 | 4 1/2 | 9 1/2 | 1 1/4 |
| ---- | 9 1/2 | 9 | 4 1/2 | 9 1/2 | 9 1/4 | 8 | 8 | 8 | ---- | ---- | 10 | 9 1/2 | 4 3/4 | 10 | 1 1/2 |
| ---- | 11 3/8 | 10 1/2 | 5 1/4 | 10 1/2 | 10 1/2 | 9 1/8 | 9 1/8 | 9 1/8 | ---- | ---- | 11 3/4 | 11 3/8 | 5 9/16 | 11 3/8 | 2 |
| ---- | 13 | 11 1/2 | 5 3/4 | 11 1/2 | 11 1/2 | 10 1/8 | 10 1/8 | 10 1/8 | ---- | ---- | 13 5/8 | 12 1/8 | 6 1/16 | 12 1/8 | 2 1/2 |
| ---- | 15 1/4 | 12 1/2 | 6 1/4 | 12 1/2 | 12 1/2 | 11 3/4 | 11 3/4 | 11 3/4 | ---- | ---- | 15 7/8 | 13 1/8 | 6 9/16 | 13 1/8 | 3 |
| ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | ---- | 3 1/2 |
| ---- | 18 | 14 | 7 | 14 | 14 1/2 | 12 5/8 | 12 5/8 | 12 5/8 | ---- | ---- | 18 5/8 | 14 5/8 | 7 5/16 | 14 5/8 | 4 |
| ---- | ---- | 15 3/4 | 7 7/8 | 15 3/4 | ---- | 15 5/8 | 15 5/8 | ---- | ---- | ---- | ---- | 16 3/8 | 8 3/16 | 16 3/8 | 5 |
| 18 | 22 | 17 1/2 | 8 3/4 | 17 1/2 | 18 5/8 | 16 1/2 | 16 1/2 | 16 1/2 | 16 1/2 | 16 1/2 | 22 5/8 | 18 1/8 | 9 1/16 | 18 1/8 | 6 |
| 20 1/2 | 27 | 22 | 11 | 21 | 22 3/8 | 17 1/8 | 17 1/8 | 17 1/8 | 20 3/8 | 17 1/8 | 27 5/8 | 22 5/8 | 11 5/16 | 21 5/8 | 8 |
| 22 | 32 1/2 | 24 1/2 | 12 1/4 | 24 1/2 | ---- | 18 5/8 | 18 5/8 | 18 5/8 | 23 | 18 5/8 | 33 1/8 | 25 1/8 | 12 9/16 | 25 1/8 | 10 |
| 25 | 38 | 28 | 14 | 28 | ---- | 20 3/8 | 20 3/8 | 20 3/8 | ---- | 20 3/8 | 38 5/8 | 28 5/8 | 14 5/16 | 28 5/8 | 12 |

# VALVE ACTUATORS

**Almost all energy-systems valves must be physically operated by some sort of actuator—mechanical, electrical, hydraulic or pneumatic. The handwheel is the simplest mechanical type; motors and solenoids are electrical; oil-operated cylinders are hydraulic; diaphragm types are pneumatic. And in each category, necessary degree of feedback can indicate valve position to operators or provide fine readjustment for precise control.**

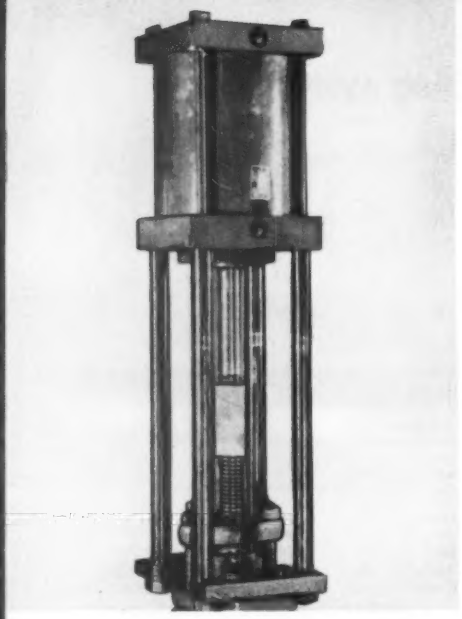
*Mechanical actuators* start with the familiar handwheel, include many novel variations that operate valves more easily and surely. At high temperatures, where binding could make turning a simple handwheel difficult, a pounding arrangement is available. Handwheel moves freely through a portion of its turn and then hits against a lug on a secondary wheel which is firmly fastened to the valve stem. The valve can then be pounded shut for tight closure, or pounded open when it's stuck shut.

Chain wheels are useful for valves that cannot be located within easy reach—up near the ceiling, for example. Chain drops from the handwheel to the floor; operator pulls at it as he would a chain hoist to open and close the remote valve.

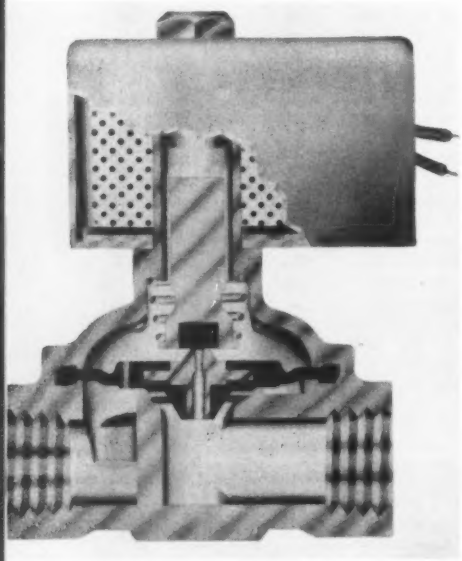
Manually operated gear heads fit many standard bonnets. This gives the operator a mechanical advantage, permitting one man to open and close a valve where two men might otherwise be needed. But since the operator will have to take several turns on the handwheel to produce one turn of the valve stem, operating time may stretch out—especially if the valve is very large and stem travel long.

*Electrical actuators* translate a remote electric signal into valve motion. The valve can be located wherever designer likes, since the operator won't have to work it in person. Electric signal can be manual from a push-button or automatic—electrically interlocked with machinery operation. In motor-actuated valves, the motor is usually a small high-speed type. A gear train then cuts speed, increasing torque to get tight closure.

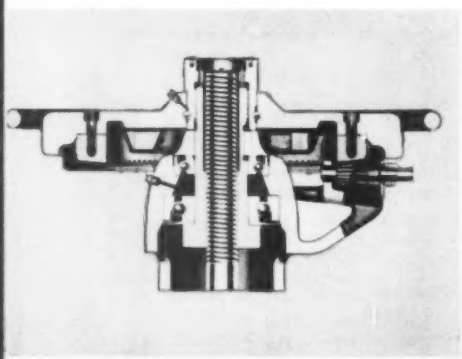
Solenoid-actuated valves are snap acting and mostly limited to small sizes. Solenoid actuators are especially popular in complex control systems needing a multiplicity of small fast-acting control valves.



**HYDRAULIC CYLINDER** for remote operation may be air- or liquid-actuated

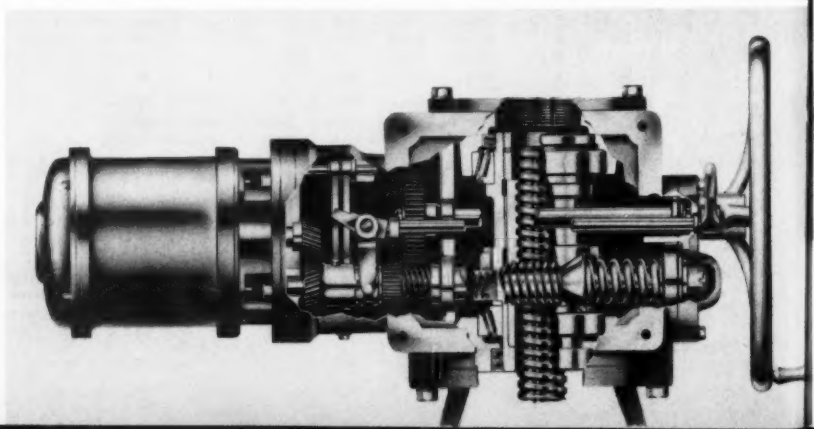


**SOLENOID-OPERATED VALVE** has an internal seal to prevent leakage into coil



**PORTABLE AIR MOTOR** operates handwheel valves through pinion, ring gear

**MOTOR OPERATOR** permits remote actuation of large valves in either direction. It can be interlocked to work automatically. Gear train boosts torque for tight closure



# range from simple handwheels to complex pilots

*Hydraulic actuators* use a duplex piston to translate signal pressure into valve-stem motion. Operation is remote. One side of the piston is exposed to pressure for control (the other side is bled). Force and travel needed to open and close the valve are attained by varying cylinder size to agree with available hydraulic pressure.

*Pneumatic actuators* translate an air signal into valve-stem motion—a signal which may be remote or integral, set by hand or automatic. Although these valves can be used for on-off, they are more popular for modulation.

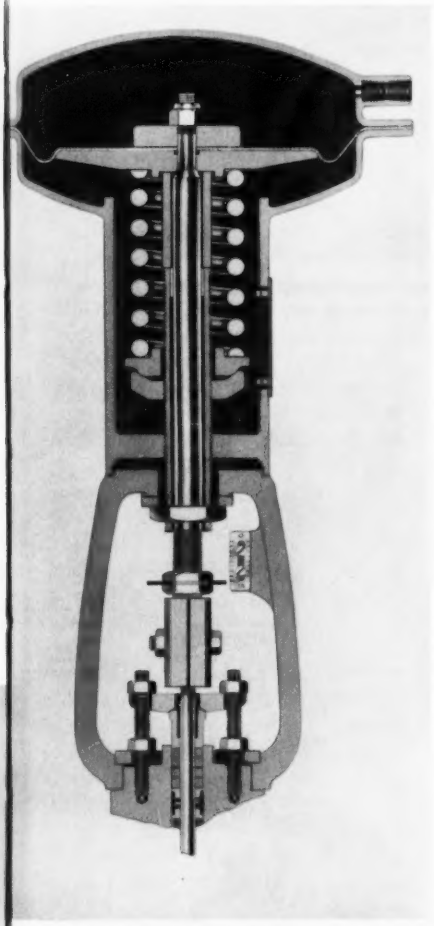
Actuators shown below translate the signal directly. That is, they have no pilot. In each case, physical arrangement is based on relationship between air signal and desired valve motion. Direct-operating actuator closes against a spring with increased air signal. If valve has a normal liquid-end element, this means air failure will cause the valve to open wide—"air-to-close" operation. If system safety requires the opposite action, "air-to-open" or fail-closed, a reverse actuator should be used.

Where two signal pressures are to control a valve differentially, spring is omitted. Duplex arrangement has a further benefit: a much higher actuating force is available for emergency operation. One side of the diaphragm can be bled, leaving no resistance to closing in the actuator.

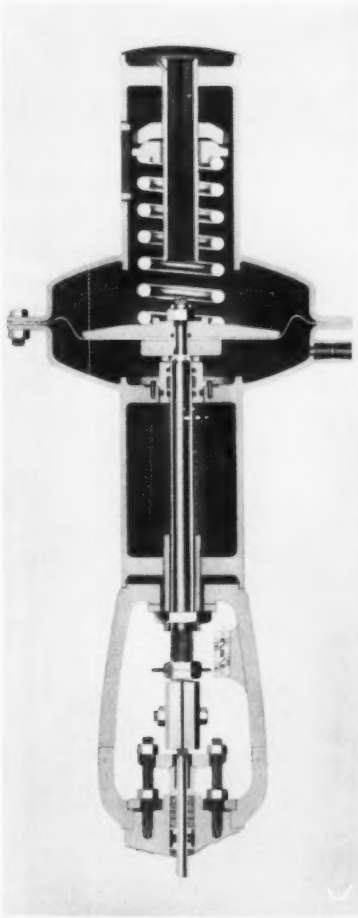
In the preloaded version, a large air dome replaces the spring. Air is usually supplied at a constant pressure from the plant air system. This design is a frequent choice for air-to-open applications. While the spring-loaded version can be set for only one range of flow conditions, pressure of the preloaded type can be adjusted to increase its power.

Pilot-operated air actuators, next page, are controlled by an auxiliary pressure supply provided by the pilot output. Pilot itself is operated by signal pressure, temperature or pressure differential. These actuators are ex-

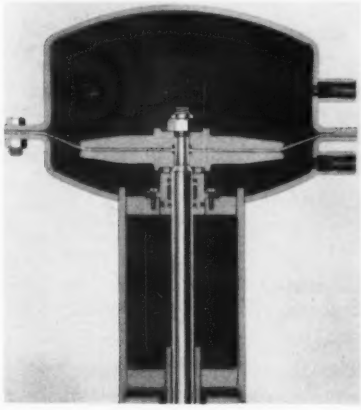
## Remote air signal drives these valve actuators to cut off or modulate fluid flow



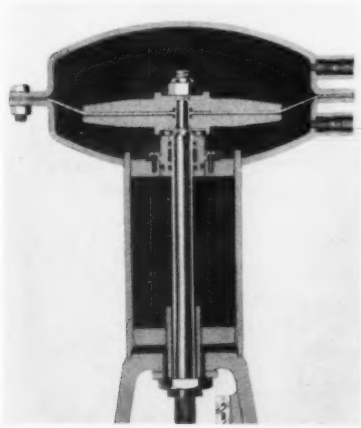
**DIRECT-ACTING DESIGN** gives "air-to-close" action with normal valve design



**REVERSE ACTION** puts spring above diaphragm for "air-to-open" operation

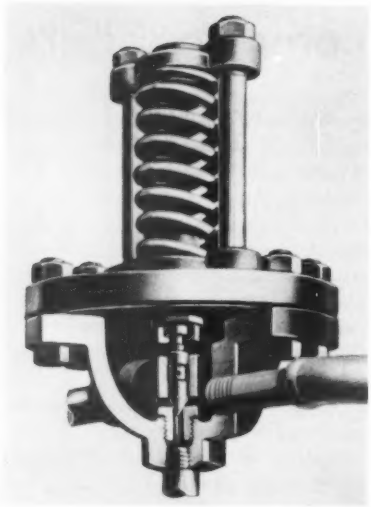


**PRELOADED DESIGN** has large air chamber to replace the reverse-acting spring

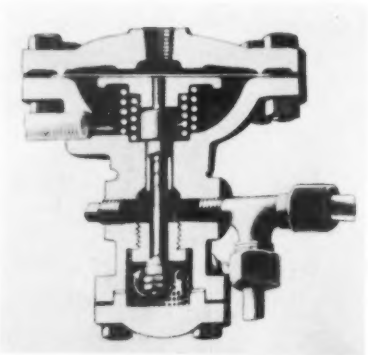


**DUPLEX DESIGN** uses a differential air signal. Operating force is adjustable

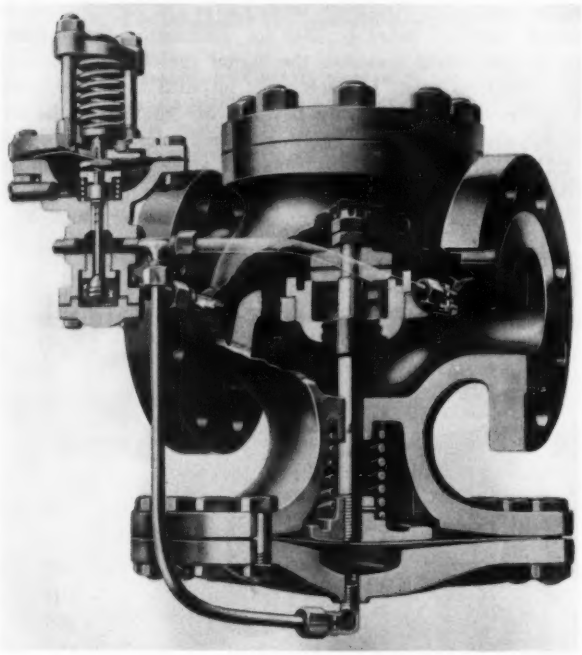
tremely sensitive and usually more suitable for higher pressures than their direct-operated counterparts. They can also be more precisely adjusted and are less affected by wide variations in demand. Any of the several pilots below are candidates for operation of main actuator and valve. In most cases you will notice a similarity between these pilots and direct-operated actuators. This is a very real likeness because the pilot's relationship to the main-valve actuator is almost the same as between direct-operated actuators and their valves.



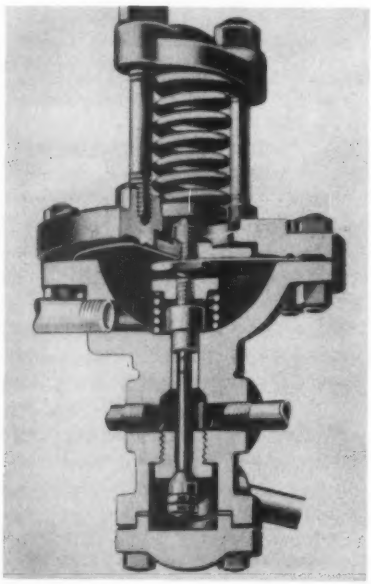
**BACKPRESSURE PILOT** is designed for "signal-pressure-to-open" operation



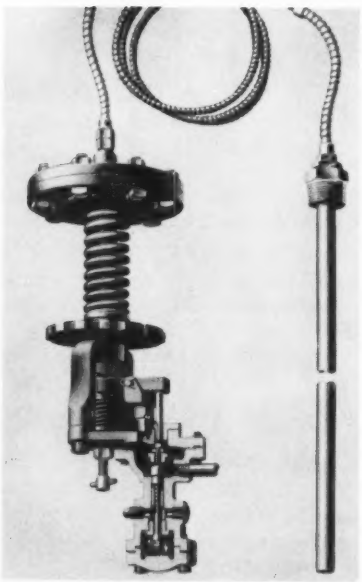
**AIR-ADJUSTED PILOT** is remotely controlled through a secondary air signal



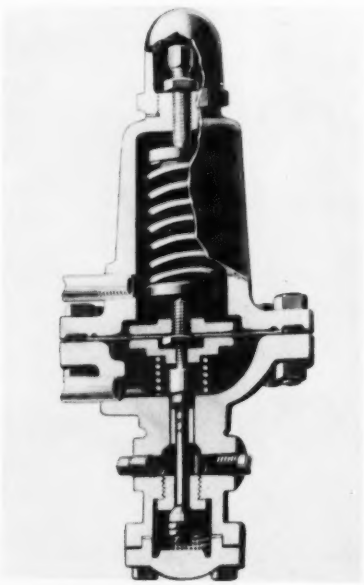
**MAIN CONTROL VALVE** can be operated through any of the pilots shown to translate a variety of signals into valve action



**PRESSURE PILOT** closes on increased signal pressure, opens on signal failure



**TEMPERATURE PILOT** translates thermal change into movement of pilot stem



**DIFFERENTIAL PILOT** receives two signal pressures, holds set differential

# MAINTENANCE ups valve life, cuts cost

**Valve maintenance really begins when the valve is selected, because proper design and materials go a long way in minimizing maintenance. A valve, like any other piece of energy-systems equipment, needs regular inspection during operation and prompt attention when troubles develop.**

Although some energy systems valves are large and individually represent a significant dollar investment, the vast majority are small and their unit cost is low. This sometimes leads to neglect during operation and hastens the need for replacement. But taken as a whole, energy-systems valves represent a significant portion of your capital outlay. And to make this investment pay off, reasonable valve life is a must. This can only be accomplished by a thorough and regular inspection program, followed up by prompt repair to minimize maintenance cost.

Let's take a look at some common valve troubles and see what happens when maintenance is neglected. To simplify our problem, assume that original application was correct and operation remains as originally designed.

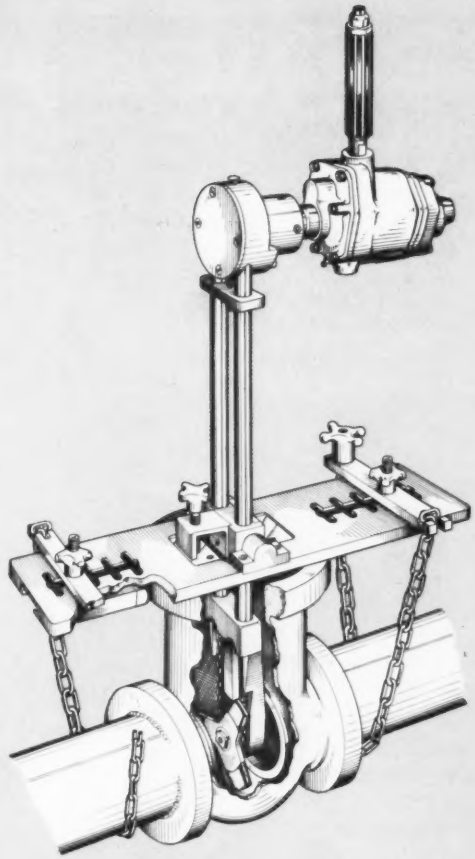
Many shutoff valves are never operated during normal plant cycles. These might be equipment-isolation valves or emergency valves originally installed for personnel or equipment safety. But unless such valves are occasionally operated they may deteriorate with time. Then, when you need them in a hurry, they just don't work. So it's a good idea to operate each valve during some idle period just to see that it does actually work. This will help detect trouble before complete failure, save repair costs, prevent damage to other equipment.

If valve packing is allowed to leak continuously, stem damage may progress to the point where no packing will hold. Then complete stem replacement is necessary. Just because a valve is hard to get at is no excuse for permitting it to leak on and on. Not only are replacement stems expensive themselves, but over a period of time the product wasted can add to operating costs.

A leaking stem frequently means a chattering valve. Chatter initiates other troubles within the valve. Vibration extends to the working parts and can damage them beyond repair. Another minus that goes with a chattering valve—accidental closing. In a critical application such as a pump suction line, accidental closing can cause extensive equipment damage and process downtime—all this because a leaking valve stem was not fixed promptly.

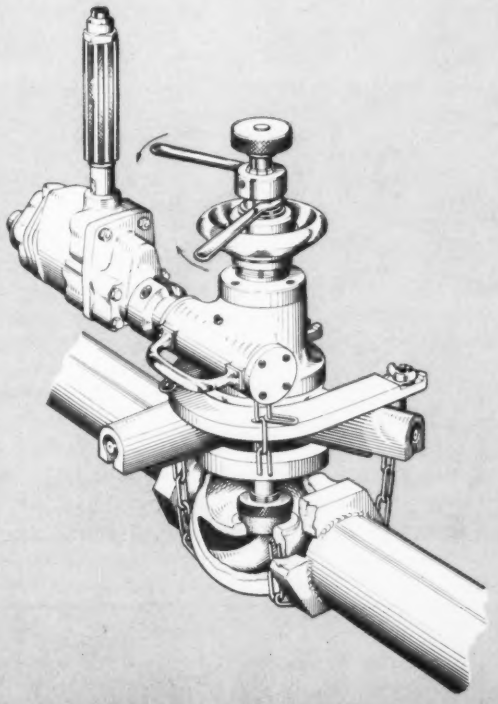
Another problem is chronically leaking valves which ultimately ruin themselves. Had they been repaired immediately, cost would have been minimum.

Advancing technology means changing processes. So a valve that was properly applied originally may later be completely wrong. Whenever your system changes, check the valves. Make sure they are still suitable. If necessary, change them; don't wait until they fail in service and perhaps shut you down. These are but a few of many areas where good valve maintenance can pay off. So check up on your maintenance practices to keep costs down.



**Valve reseaters**

**In large plants with many integral-seat valves, reseaters can pay off. Gate-valve reseater,- above, features mechanical feed which seeks and holds the plane of the valve seat. Globe reseater, below, is driven by an air motor and uses abrasive cloths which attach to the grinding head.**

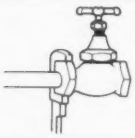


# There's a right way to treat your valves

Even a properly applied energy-systems valve can fail to give good service if it is not properly installed and properly used. Check each of these installation and operation pointers. There are always many wrong ways, but there is usually only one right way. So our illustrations highlight the *right* way.

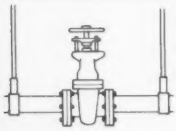
Next, look around your plant for other bad valve practices. In each case figure out how the job should be done and add it to your list. Then review the entire list and use it as a guide to weed out all incorrect practices. This can be done by operator and maintenance-man education. You'll find reduced valve replacement brings down costs.

## Start off with correct installation

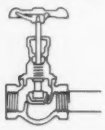


When installing a screwed valve, always put the wrench on the hex nearest the pipe. This supports the valve—otherwise applied torque can bend the valve body

Always be sure a gate valve is closed before installing it. If left in the open position, it can be twisted. Then valve disk and seats may not mate properly; valve will leak

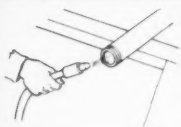


Using proper hangers close to both sides of a valve will go a long way in reducing stresses transmitted by piping. Most valves are not designed for external stressing

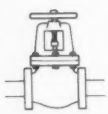


Thread pipe for screwed valves to standard length only. Joint will then make up tight before pipe end strikes the seat. Otherwise you risk a leaky joint, distorted valve body

Put pipe compound on the pipe end, not into the valve threads. In this way, compound won't get on the valve seat where it may collect dirt, prevent tight shutoff

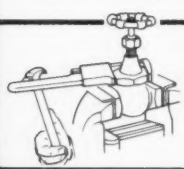


Always blow out or otherwise thoroughly clean pipe sections before they are installed. Dirt or metal chips may have worked in; they'll destroy valve seats



Wherever possible, be sure valve disks or plugs have a satisfactory gravity drop. This is especially important with check valves of most types to start closing upon zero flow

## Then check for proper operation



When screwed bonnets are hard to remove, use a short wrench and tap it a few times with a hammer. This is more effective than a sustained pull, cuts distortion risk

If a valve leaks slightly when shut off, open it a little to flush particles that may keep it from seating. Don't try forcing it shut with a bar—this can completely ruin the seat

For throttling, always use globe valves or other types designed for this job. Never use a gate valve—it will not throttle properly, may be ruined for on-off service



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# Coming: the automatic coal pile

## Fuel handling moves away from old manual operations as another step toward automating central-station power plants

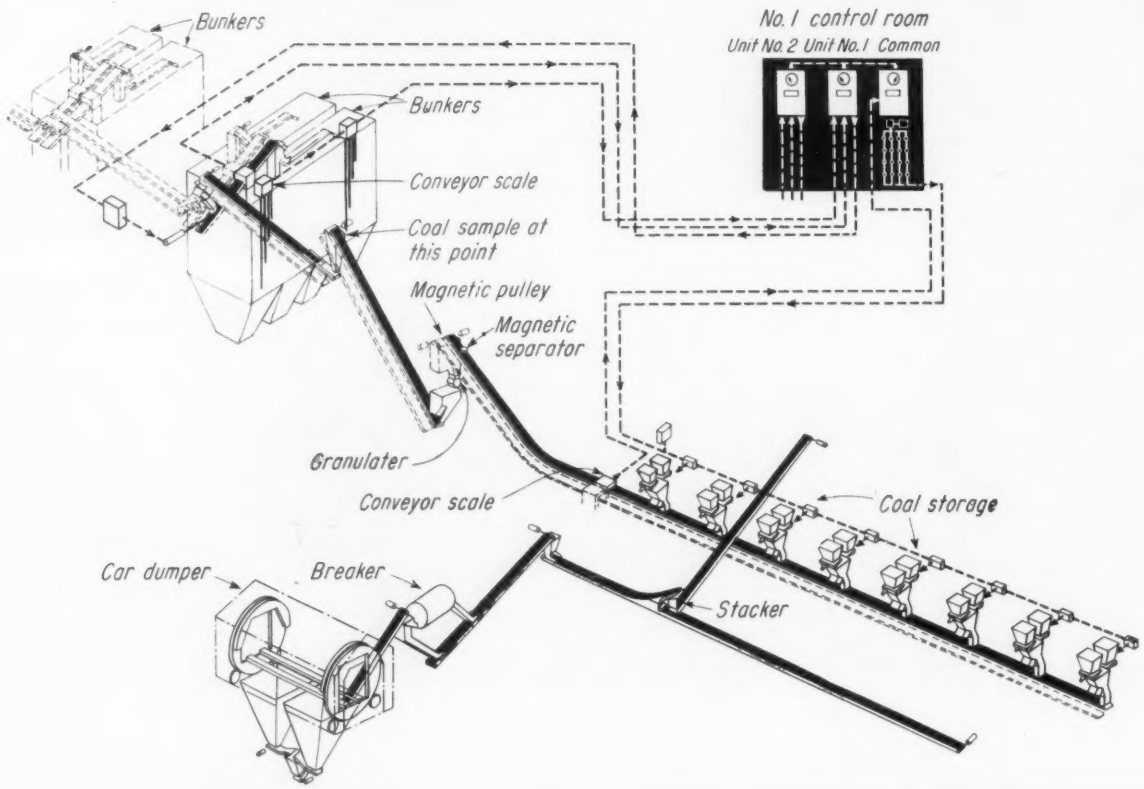
By L E STEWART, Associate Editor

Within the last few years many articles and technical papers have gone into broad concepts of the automatic plant. As the first two units to come near full automation go into service, discussion of certain design details gets warmer and warmer. We now find there are two equally valid approaches to the fully automatic plant: almost complete automation at one jump, or a step-by-step development of its various aspects. Although it's less spectacular, the second approach seems to find favor with the majority of utility engineers. This is particularly true where coal-fired plants bring in the added complexities of fuel and ash handling.

Before we see how some current developments tie into full plant automation and how they affect plant design, let's spend a moment defining problems of automating the coal-handling function.

**From the in-plant hopper** on, coal handling is already at a high level of automation. At least, automation techniques and equipment are available and, by and large, proved in operation. Automatic coal valves, feeders and damper drives plus instrumentation for monitoring and controlling the entire fuel-handling operation from hopper to burner exist to some degree in many plants.

This is the story within the plant. But that large portion of the fuel-handling system *outside* the actual building is a different problem. Coal brought by barge, train or truck must




be unloaded, sorted for storage or current use, then crushed or otherwise processed and finally transported to indoor hoppers. In the past, these outdoor operations were more or less manually controlled by yard crews working one or two shifts per day. Indoor hoppers had to be big enough to store coal for more than a full day.

**Several modern power plants** have systems that demonstrate the various tacks taken by coal-pile automation. Let's look at three of them: Detroit Edison Company's River Rouge Plant, Tait Station of Dayton Power and Light and Metropolitan Edison's Portland Station.

**At the huge River Rouge Plant** of the Detroit Edison Company, a coal-handling system capable of transporting 1100 tons per hr to plant bunkers was automated for safety and efficient operation. Two men actually control flow of coal from the dock hopper to storage yard or the plant bunkers. One operator in the breaker house controls the 2500-ton-per-hr system from the dock hopper either to the automatic stacker-conveyor or to the second transfer house on the way to the plant bunkers. He also controls movement of coal from the storage yard to the second transfer house when there's no ship unloading. The second operator controls coal flow from the second transfer house, along the 1100-ton-per-hr distributing conveyors, on to the self-powered tripper that feeds the plant bunkers.

Operation is semiautomatic, coupled with remote manual control. Once the operator decides it's time to stack out incoming coal, the automatic stacker takes over. Conveyor moves in a 165-deg arc in piling. When coal accumulates to a preset height under the stacker, stacker swings to a new position. When 20,000 tons have accumulated under the stacker, or when it reaches the end of its travel, it automatically shuts down.

Bunker loading also follows automatically, once operator selects which bunkers and sets the rate of loading. The self-powered tripper positions itself over the correct bunker and delivers a uniform weight of coal the length of the bunker.

**Safety shutdown** and warning interlocks keep this giant system firmly under the two operators' thumbs. In addition, the coal-handling staff patrols the system, watching for trouble points. A safety cord runs along the entire course so a patrolman can shut off flow of coal if he spots trouble. When he pulls the cord, point of disturbance registers on the control panel. Then the panel operator can pinpoint the trouble for the coal-handling staff.

**Automatic coal sampling** is important for today's semiautomatic unit but doubly so for the fully automatic plant. At River Rouge, the coal-handling system includes an automatic sampler at the first transfer

## Portland Station ties coal-transportation control to bunker-level measurements

Metropolitan Edison Company's Portland Station represents another giant step toward automating the coal pile. From the active storage pile to the plant bunkers, operations are semiautomatic, while sequence from car dumper to traveling stacker is controlled manually from one location.

Manual controls, interlocked for sequential starting and automatic tripping, are located in the car-dumper control house. There is less real incentive to automate this part of the system because many plants will need men at the car dumper and stocking-out tower for some time to come.

Semiautomatic equipment is controlled from a panel located in control room of Units 1 and 2. On this panel are grouped all controls and recorders for the portion of the system common to the entire plant, and, in addition, bunker-feed controls and recorders for Units 1 and 2. Other units will have their bunker-feed controls in their own control rooms.

Here's how the semiautomatic section operates: 16 vibrating feeders under the active storage pile feed one of two 500-ton-per-hr belts running into the plant. Enough 50-ton-per-hr vibrating feeders are placed in service from Unit 1 control room to handle plant load. On the main belt, a coal scale regulates load to station, based on total signal from individual-unit load demands. Individual-unit feeders are sized to handle twice full-load flow. If main belt should feed coal faster than feeders can take it away, conveyor interlocks stop the main system and sound an alarm.

Unit-feed controls consist of manual rate setting in the control room plus level control for each bunker. As level changes in bunkers, capacitance probes mounted at each end of the bunker control the unit and vibrating feeders. Probes supply high-level alarm, intermediate high-level control, intermediate low-level control and low-level alarm.

When intermediate high-level probe is covered by coal, vibrating feeder cuts back total flow to belt. After a time delay, the unit feeder and unit belt both stop. When level drops to bottom of intermediate low-level probe, the unit feeder starts up again, adding its signal to the total sent to the vibrating feeders.

Level-probe circuits supply data in the form of signal lights and alarms to unit-feeder control panels.

house on the way to the plant bunkers. This cuts out a continuous sample as coal discharges from the conveyor. Samples are relayed by a small conveyor belt to a special sample crusher and thence to the lab for analysis. Whenever coal is transmitted to the plant the sampling system operates.

Although a large part of the coal-handling system at River Rouge has been automated, prime responsibility for selecting feed rate and distributing coal to bunkers rests with two operators. The human element remains much in evidence. Now, let's look at a somewhat different line of development.

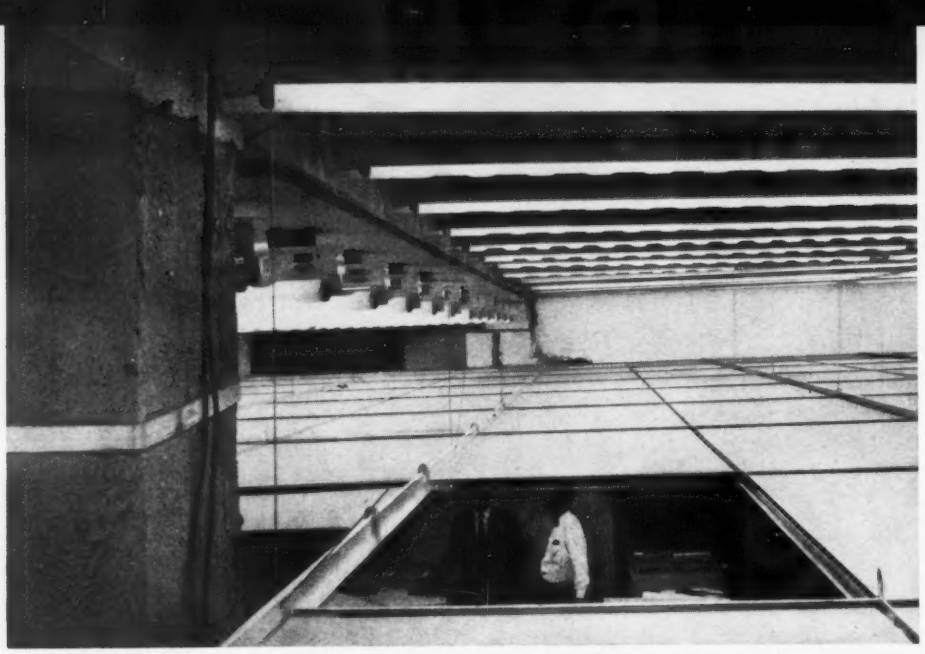
**Tait Station** of Dayton Power and Light votes for centralized control of coal handling. A materials-handling control cubicle in the main powerplant building lets one man regulate distribution of coal from car dumpers to final bunkers. This single operator may elect to transport coal to any of three points in the plant: original plant storage bunkers at up to 300 tons per hr, new plant bunkers at up to 800 tons per hr, yard storage at 400 tons per hr maximum.

**Coal-distribution rate** is automatically controlled by an electronic system which accurately weighs coal on the conveyor belt and balances belt speed to keep the desired weight rate. Cubicle controls fully interlock and sequence the operation, and the entire system is monitored by supervisory instruments.

At Tait Station, selection of rate and point of discharge still remain in the hands of an operator. But the operator is responsible for selecting only a prime variable—tons per hr—and passing it on to the automatic control system, which makes appropriate corrections to maintain that weight rate. Tait's coal handler depends entirely on his instrumentation once he's made his basic decisions.

**Portland Station** of Metropolitan Edison has gone the farthest, to date, in automating the coal pile. Diagram and description above indicate the extent of automation its designers have incorporated in this plant. Some human decisions remain, but they are not as subject to constant review and change. The operator selects rate of feed for each unit's bunkers, based on unit generation. Bunker-level controls take it from there; they control feed for individual units and the total plant load. If unit firing rates vary from set feed rates by more than a certain amount, the system operator has to reset his feed rates.

**What's next?** Plants like Portland will be tested out for some time to find system limitations—for instance, reduced flexibility of operation with poor coals caused by hangups, trip-outs, etc. When operators are satisfied that controls are dependable, the stage will be set for some plant to program feed rates from boiler's required Btu input. Once that is done, computers can take over another plant area.



**LUMINOUS CEILING** has uniform height; height of old ceiling varies. Reflector fixtures, right, are suspended

**LIGHTING PLAN** for executive enclosures, located along outside walls, is same as for large general office space

High lighting levels and air conditioning are demanded of modern office buildings. Here they are integrated for heat efficiency as . . .

# Building relights at 200 foot-candles

How can an older commercial building move up to the front ranks of modern business offices? One important step is to equip it with a type of lighting that provides superior seeing. This is what Rochester Gas and Electric Corp is doing at its headquarters building in downtown Rochester, N.Y. Salient feature of this far-reaching building-facility renewal is 200 foot-candles of illumination with shielding that provides maximum seeing comfort.

Air conditioning is closely integrated with lighting, and heat produced by the lighting system provides nearly all required heat during the cold months. Renovation of three floors of the 10-story, 35-yr-old building is complete, and the others are expected to be updated within the next year.

**Total cost** of modernizing the lighting, heating and air-conditioning systems in the 150,000-sq-ft structure will be about $1,500,000. This involves $600,000—$4 per sq

ft—for lighting and $900,000—$6 per sq ft—for air conditioning and heating. Going to 200 ft-c cost much less than expected, "nowhere near" double the cost of installing a 100-ft-c system, according to RG&E.

**Benefits** of higher lighting levels will more than compensate for increased owning and operating costs, RG&E believes. Improved lighting is expected to increase employee efficiency by providing conditions for faster, easier and more accurate seeing for their various tasks.

Assuming one $4000-per-yr office worker for each 100 sq ft of floor area and a lighting-load increase of 3 to 10 watts per sq ft, the utility expects it will take an improvement of worker efficiency of less than 1% to offset increased owning and operating costs of the new system.

**Lighting system** used on the sixth floor is a standard louver installation with single-lamp grooved high-output fixtures mounted above 2x4-ft grids using circular plastic louvers for shielding. The lamps are spaced on 30-in. centers. In new section of the building they're mounted 23-in. above the louvers, 18 in. in the older section. Reflectors are used above the lamps in the new section.

The second system—that on the seventh floor—features open-top 2-lamp grooved high-output troffers recessed in a plastic-louvered ceiling. Louvers are standard circular-plastic type between the fixtures and a higher-density plastic directly under the lamps, giving a brightness ratio of 2:1. Finished ceiling on this and other floors is maintained at 8.5 ft, just 2-ft lower than the original.

The third system, installed on the fifth floor, features 4x8-ft elements with four grooved high-output lamps in each. Between these elements and in the fixtures themselves, white-painted aluminum louvers are installed.

Lighting in the elevator lobbies is supplied by standard 4-lamp 40-watt surface-mounted units with glass. Corridors have 2x4-ft 4-lamp recessed troffers with glass. The lunchroom is lighted with 150-watt recessed incandescent units, and six hanging fixtures provide decorative lighting. Draperies are lighted with 150-watt floodlights.

When RG&E first occupied the building in 1926, 15-ft-c lighting levels were provided by 300-watt incandescent units, one for each 10 sq ft of floor space. Later, to increase lighting levels to 25 ft-c, bulb wattage went up to 500. But that made the fixtures uncomfortably hot and bright, so in 1950 most of the incandescent units were replaced by a fluorescent system—continuous rows of suspended fixtures on 8-ft centers, each with two 40-watt preheat lamps. These increased lighting to 60-ft-c average.

**Air-conditioning** and heating systems use much of the same equipment. Under-window induction units with large coil capacity are served from a 3-pipe system. They get hot or chilled water as room temperature requires—each room or area has automatic temperature control.

Ample steam capacity and freedom from noise and vibration prompted RG&E to use an absorption-refrigeration plant. Location—in the building's penthouse—cuts condenser-water and chilled-water piping and pumping costs. The penthouse plant will serve the entire building.

Lighting system produces enough heat for the building in winter, except in peripheral areas. Supplementary heat is required under the windows. A high-pressure dual-duct air system, used to reduce excessive heat in internal areas, has individual mixing boxes for each office or zone and diffusers level with the bottom of the ceiling. High and low returns take air back to the apparatus rooms; return air can be used again or exhausted to the outside. During warm months the lighting system's heat exhausts from the building to reduce the air-conditioning load.

**Principle air-conditioning equipment** includes:

*Refrigeration.* Two absorption units with a total capacity of 760 tons supplied by York Div, Borg-Warner Corp. Primary water temperature: 42 F, secondary water temperature: 52 F.

*Cooling towers.* Three towers (1 winterized) supplied by Marley Co. 87 F off at 93-78 F wet bulb.

*Air systems.* (1) Tenth-floor fan system has single-duct hot-water reheat coils and a 10,000-cfm unit from Clarage Fan Co. (2) Perimeter system, second through tenth floors, has 3-pipe high-velocity induction units by York; 30,000-cfm Clarage fan. (3) Interior system, second through ninth floors, has double-duct medium-velocity units with mixing boxes and a 100,000-cfm Clarage fan.

*Controls.* Central control board in basement supplied by Johnson Service Co.

*Ceiling diffusers* supplied by Anemostat Corp. Return-air fans and interlocked dampers permit varying outside and exhaust air. There are both high and low returns.

**Basic lighting-system equipment** includes:

*Seventh-floor lighting.* Power Groove high-output lamps by General Electric Co. Most of the lamps—317 of them—are 8-ft units in 2-lamp 450-watt fixtures. Shielding: Circlgrid by J A Wilson Lighting, high-density under lamps, standard between fixtures—highest brightness under lamp to lowest brightness between fixtures in 2:1 ratio. Fixture manufacturer is Morelite Equipment Company. Lunchroom has standard filament-lamp recessed Gotham downlight fixtures and 150-watt "wall-washing" unit at the draperies.

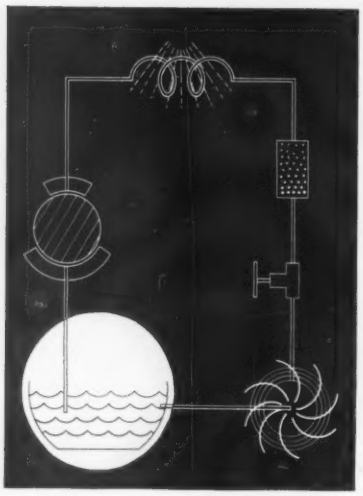
*Sixth-floor lighting.* Power Groove high-output lamps and ballasts by General Electric. Most—470—are 8-ft lamps. Shielding is Circlgrid of standard density throughout. Fixtures by Pittsburgh Reflector Company and Flangelamp Company. Lighting has uniform brightness

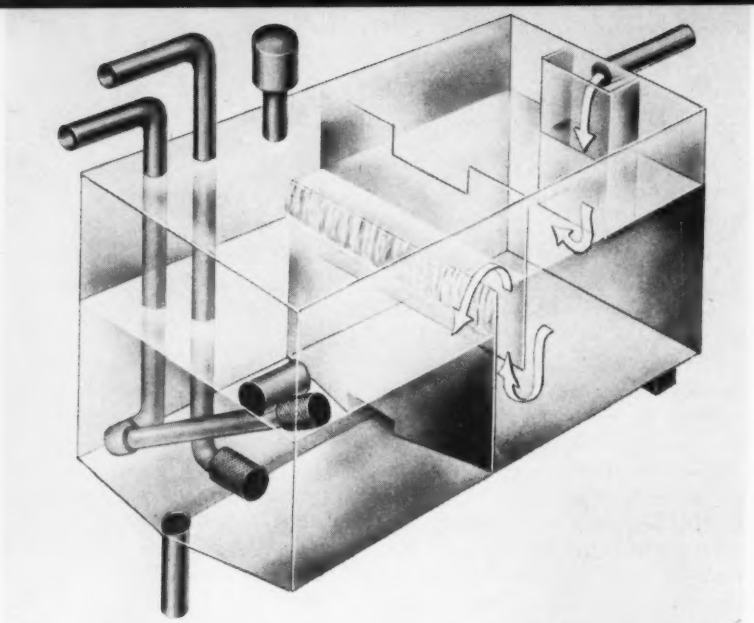
*Fifth-floor lighting.* Power Groove high-output lamps and ballasts by General Electric. Most—466—are 8-ft lamps. Shielding is provided by ¾-in. aluminum louvers painted white. Brightness ratio, from highest under lamps to lowest between fixtures, is 4:1. Fixtures are manufactured by Litecontrol Corporation.

**Elevator lobbies** are lighted by Sylvania 4-lamp 40-watt RS surface fixtures with Corning No.-70 glass, 2x4 ft. In toilets, all lamps are GE Homeline fluorescents. Fixtures are Lightolier 2-lamp 40-watt RS surface fixtures with a molded Plexiglas lens. Women's rest rooms use Daybrite 6-lamp 40-watt RS recessed-lens units, 4x4 ft.

Office lighting uses some Sylvania and Westinghouse high-output lamps in addition to GE lamps.

LUBE—part 2





**MODEL RESERVOIR** includes a simple baffle arrangement for foam separation. Alternate suction types, deep and floating, are illustrated. Reservoir bottom slopes to drain

# RESERVOIRS for circulating-oil lube systems

## Design of reservoirs must satisfy many conflicting needs —they must be large enough to permit impurity separation yet small enough to minimize cost and space

By E R BOOSER and D A SMEATON, General Electric Company

In part I of this lube series (POWER, April 1961, pp 69-71) we discussed some of the overall characteristics of a forced-circulation oil-lubrication system. They stem from the three major factors of environment, oil function and reliability. Now let's see how these factors fit in with the fundamental requirements of flow and heat transfer to affect component design. This month we'll take a look at the reservoir.

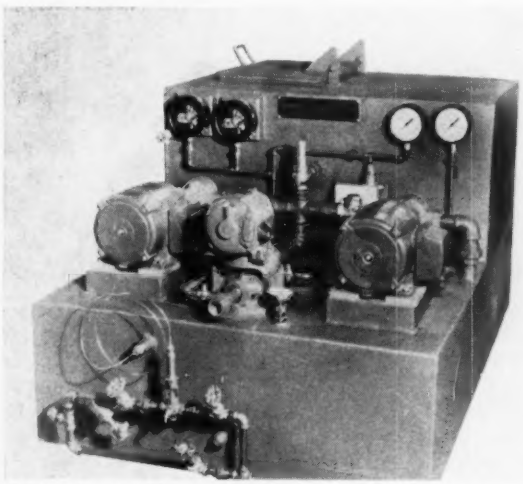
Current trends toward system compactness have increased the importance of reservoir design—after all, it is the largest single component in the lube system. And in addition to being just a storage vessel, it can serve other functions. Among them: settling tank, foam separator, structural support for piping and accessories and deaerating chamber. Even its top surface is now being used to mount pumps and as a console for valves, filters, gages and regulating equipment. Coolers also may mount in or on top of the reservoir to save valuable space.

To meet this array of design requirements, factors such as capacity, proportions, location, materials and baffling need very careful consideration in reservoir design.

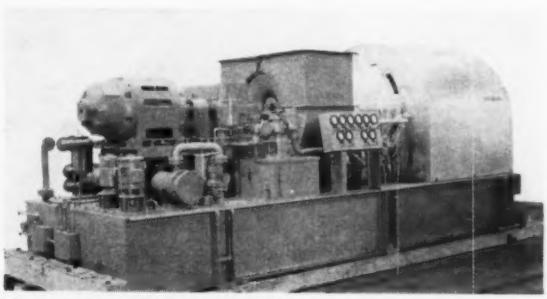
**Reservoir capacity** must let the oil "dwell" long enough for entrained air—foam—to separate out and for water and solid impurities to settle by gravity. As a rule, the smallest reservoirs hold 3 to 7 times the volume of oil circulated per minute through the system—giving a 3-to-7-minute dwell. These relatively short dwell times apply for low-viscosity oils in electric motor and turbine systems where contamination and foaming are often minor. And the dwell time can be dropped even further—to one or even one-half minute—in cases of extreme space or weight limitation. Aircraft engines are a good example.

At the other extreme, a 40- to 60-minute dwell time is common in paper-mill lube systems where water contamination is the problem. Long dwell times are also common in small, 1- to 2-gpm machine-tool systems where reservoir capacity is needed to accommodate the large portion of oil held in piping when the system is operating.

**LARGE LUBE RESERVOIR,** engineered for a specific application, has many lube-system components mounted directly on its top



**SMALL RESERVOIR,** standardized by Dravo Corp to suit many applications, integrates system components into a neat package



**RESERVOIR FOR GAS TURBINE** is incorporated in base plate. Enclosed base structural members form the oil-return passages

Of course, small standardized systems designed with long dwell times can handle a wider range of applications.

**Oil-circulation rate** is determined by adding together the requirements of all components. Example: in a paper machine with 250 drying rolls—500 bearings—each bearing might require about 0.5 to 2.0 quarts a minute. Total oil needs might run about 100 gpm. With a 50-minute dwell time, from table 1, this flow would indicate oil-reservoir capacity of 5000 gal. But a 2-tank arrangement is often used in paper and steel mills. Then one tank is in use while the other is idle, letting contaminants settle from the oil. Tanks are alternated on perhaps a weekly basis. Each tank in a dual arrangement contains about one-half the total capacity—2500 gal in our example—since the dwell period is reduced.

**1—Equipment served governs dwell time in reservoir**

| Equipment served | Dwell time, min |
|---|---|
| Steam turbines | 5 to 10 |
| Gas turbines | 5 |
| Electric motors | 5 to 10 |
| Steel-mill machinery | 20 to 40 |
| Paper-mill machinery | 40 to 60 |
| General industrial machinery | 30 to 100 |

Extra capacity should always be allowed in a reservoir design so tank is never completely filled. Variables such as thermal expansion, turbulence, foam and system fluctuations demand this extra volume. Typical designs call for a 6-to-8-in. free space above static oil level. In small reservoirs this amounts to about 30% of the total volume, going down to the neighborhood of 10% in larger reservoirs. Operation without this free space is risky—backpressure might block the oil-return lines, and foam and oil might overflow the vent.

**Proportions** are dictated many times by floor area and available headroom. But system factors, too, must be accounted for in any design. Low depth of oil permits faster escape of entrained air and quicker settling of water and solids. On the other hand, a long tank places the main pump suction farther from the oil inlet to give the longest possible oil path. These factors work out to the following typical reservoir proportions:

Width = height

Length = 2 x width

Table 2 shows typical reservoir dimensions for capacities from 145 to 12,900 gal.

Reservoir bottom should always slope away from the oil entrance, about one in. per ft, toward a drain at the other end. Pitched bottom collects water and solid contaminants which then can be drained away.

**Location** is an important point. Since gravity drainage of the complete oil system is always desirable, reservoirs are usually located beneath the equipment served. In fact, the reservoir may be located as much as 15 to 25 ft below a large piece of equipment, so drain lines can slope down to the tank. This places many reservoirs in basements or pits specially excavated below operating floors—reducing oil-leakage problems and fire hazard.

For smaller units, convenience usually governs reservoir location. Or—added simplicity—reservoir can be originally designed right into the base of the machine served. The tank may be a welded-steel structure integral with the base-plate I-beams.

continued

## 2—Reservoir proportions for various capacities

| Capacity, gal | | Dimensions, ft | | | Empty weight, lb |
|---|---|---|---|---|---|
| Operating | Tank total | Length | Width | Height | |
| 100 | 145 | 3 | 3 | 2 1/4 | 500 |
| 500 | 575 | 6 | 4 | 3 1/2 | 1400 |
| 1000 | 1150 | 9 | 5 | 3 2/3 | 2100 |
| 2000 | 2200 | 10 | 6 | 5 1/4 | 3350 |
| 4000 | 4400 | 14 | 7 | 6 1/4 | 5300 |
| 8000 | 8700 | 21 | 9 | 6 1/2 | 10,595 |
| 12,000 | 12,900 | 26 | 9 1/2 | 7 1/3 | 12,930 |

Courtesy of Dravo Corp

**Material** for reservoirs is usually steel plate, fabricated and welded. Size, oil depth and internal pressure or vacuum govern thickness. For tanks up to 1000 gal, 10-ga sheet is typical; 4000-gal tanks use 3/16-in., 5000-gal and larger use ¼-in. plate. Outside placement of structural members gives a smooth interior—easing cleaning and minimizing turbulence. More frequently, however, structural supports are internal to make the outside look neat. In any event, interior surfaces should be sandblasted, pickled and coated with a corrosion-preventive paint unaffected by oil.

**Oil flow paths and baffle design** are vital; they determine how well the reservoir prepares oil for reuse in the system. Oil usually returns to the reservoir through horizontal lines at or just above oil level to minimize splashing and the introduction of foam. Sometimes return flow is directed over a combination of trays and screens, again to keep splashing down and help defoam the oil.

When gear units are served, oil return discharges slightly below the surface to keep air pressure caused by gear windage from backing up into the bearing housings. Discharges from relief valves, pressure regulators and separate oil-purification systems are free of contaminants or air, so they discharge six in. or more below oil level to avoid splashing.

Once oil is safely in the reservoir, its flow pattern is governed by internal baffles. More-effective use of these baffles has been functional in making possible today's trend toward smaller and smaller reservoirs and shorter dwells. Baffling lengthens path to the oil pump, promoting better separation of impurities and better heat transfer if heaters or coolers are mounted in the reservoir.

A simple baffle would be a vertical plate dividing the reservoir into two compartments. Its height should be about two-thirds of normal oil level; a small opening in the bottom equalizes oil levels and provides compartment drainage. Baffling can be integral with a heater or cooler to direct oil back and forth across heat-transfer surfaces.

Oil-pump suctions should be placed about 6 to 12 in. above tank bottom so no settled dirt or water will pick up. But they also must be kept well below lowest oil level to avoid sucking air and losing prime on the pumps. Where oil level varies widely, a floating suction with attached strainer will often meet both these needs.

**Vents** pass off moisture and vapor which collect above the oil. As level in the reservoir rises and falls and oil temperature fluctuates, air is alternately drawn in and expelled from the tank. So a filter should be a part of the vent, preventing atmospheric dust from getting in to contaminate the oil in the tank. Large lube systems frequently provide a vacuum source to keep down amount of air above the oil and remove water vapor and gases—hydrogen, for example, if system services oil from a hydrogen-cooled generator. In paper mills, forced-air circulation across the oil surface helps evaporate water.

In addition to the vent, a manhole (or handhole in small reservoirs) above maximum oil level should be provided for tank inspection and cleaning.

**Accessory equipment** that can be included in a reservoir design is limitless. Choice of accessories depends on equipment served by the lube system, but certain items are almost always there. Some of them: oil-level indicators, low-oil-level alarms, temperature indicators, overflow fittings, sight flow gages on the return lines and pressure or flow gages on delivery lines.

Where high-viscosity oils are required by the equipment served, or in areas of low ambient temperatures, steam coils preheat the oil before startup to avoid overloading the oil-pump motor. Or where steam is not available—in gas-turbine applications, for instance—electric immersion heaters may be used. With lighter oils, as in a steam-turbine system, pump motors are sized to handle the oil at ambient.

*Later articles in this series will cover other lube-system components, control and maintenance.*

# Gas-cooled nuclear reactors promise to lead the field

**On world-wide basis, gas-cooled reactors lead the list of nuclear plants in installed capacity. Early application of high steam pressures and temperatures offers high thermal efficiency that should lead to low production costs**

Britain and France lead the pack in application of gas-cooled graphite-moderated nuclear reactors. The U.S. and other countries now have embarked on sizable gas-cooled programs, making this type the dominant nuclear plant for the immediate future, Table 2.

British Calder Hall reactor, commissioned in 1956, was the first gas-cooled power reactor, followed by others of similar design. Natural uranium fuel in these reactors limits coolant outlet temperatures to 750 F and burnup to 3000 mw-day per ton.

The High-Temperature Gas-Cooled Reactor (HTGR), sketch, is one of the latest designs. It shows marked advancement over the first reactors. This 40-mw unit will power the Peach Bottom Station of Philadelphia Electric Company, table 1. The HTGR will have 20 times higher power density than the first Calder Hall unit; outlet coolant temperature has been raised to 1380 F.

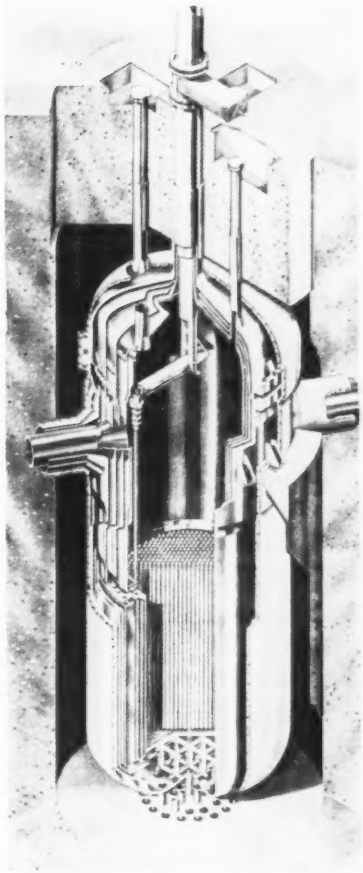
Higher densities and temperatures have been made possible by using graphite-clad slightly enriched uranium-carbide fuel dispersed in graphite. The arrangement limits radiation damage in fuel elements, so burnups can be pushed to a record 70,000 mw-days per ton.

The Peach Bottom reactor will have two loops, each with a steam generator and gas circulator. Generators will produce 366,000 lb per hr; each generator is about 8-ft dia and 30-ft high. The single-stage centrifugal helium circulators will draw 2500 hp each, about 8% of total plant output. Despite the high auxiliary-power need, overall plant thermal efficiency is 34%.

Sketch shows the reactor layout. Helium enters the vessel through the annulus of the concentric pipe, cooling the vessel before flowing upward through the core. Since inlet gas is at 660 F, the vessel can be made of carbon steel. About two ft of graphite surrounds the core and acts as the neutron reflector.

A fail-safe system drives control rods into the core from the bottom. This arrangement frees the top for fuel handling with minimum disassembly complications.

For more details of this plant, see the American Power Conference paper by P Fortescue, T G Le Clair and C L Rickard of General Atomic, a division of General Dynamics Corporation of San Diego, Calif.



**HIGH-TEMPERATURE** Gas-Cooled Reactor will be installed at Peach Bottom Station on Philadelphia Electric Company system

## 1—High-Temperature Gas-Cooled Reactor data

| | |
|---|---|
| Net electrical power, mw | 40 |
| Reactor thermal output, mw | 115 |
| Net thermal efficiency, % | 34 |
| Steam pressure, psia | 1450 |
| Steam temperature, F | 1000 |
| Max fuel-surface temperature, F | 2300 |
| Coolant | Helium |
| Coolant pressure, psia | 350 |
| Coolant inlet temperature, F | 660 |
| Coolant outlet temperature, F | 1380 |
| Uranium investment, kg | 150 |
| Thorium investment, metric tons | 1.2 |
| Core diameter, ft | 9.0 |
| Core length, ft | 7.5 |
| Fuel-element diameter, in. | 3.5 |
| Number of fuel elements | 810 |
| Reflector thickness, ft | 2 |
| Pressure-vessel inside diameter, ft | 14 |
| Pressure-vessel height, ft | 34 |
| Burnup, mw-days per metric ton | 70,000 |
| Core life, yr (80% load factor) | 3 |

## 2—World-wide reactor progress

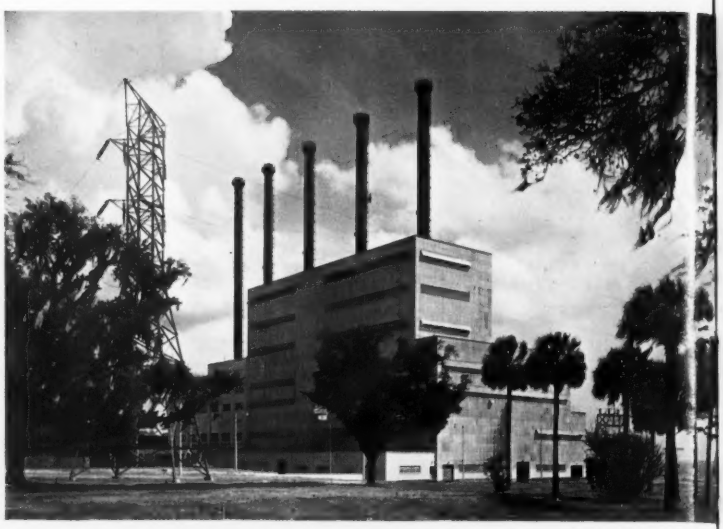
| | Capacity, mwe | |
|---|---|---|
| Type | Operating | Under construction |
| Organic moderated | — | 12 |
| Fast | 15 | 110 |
| Sodium graphite | 6 | 75 |
| Heavy-water moderated | — | 414 |
| Boiling water | 195 | 482 |
| Pressurized water | 196 | 1166 |
| Gas-cooled graphite | 360 | 4450 |

***FLORIDA POWER CORPORATION'S***
***TURNER STATION***
*Enterprise, Florida*

Unit No. 4 is a 600/000 lb/hr
RILEY TURBO FURNACE BOILER

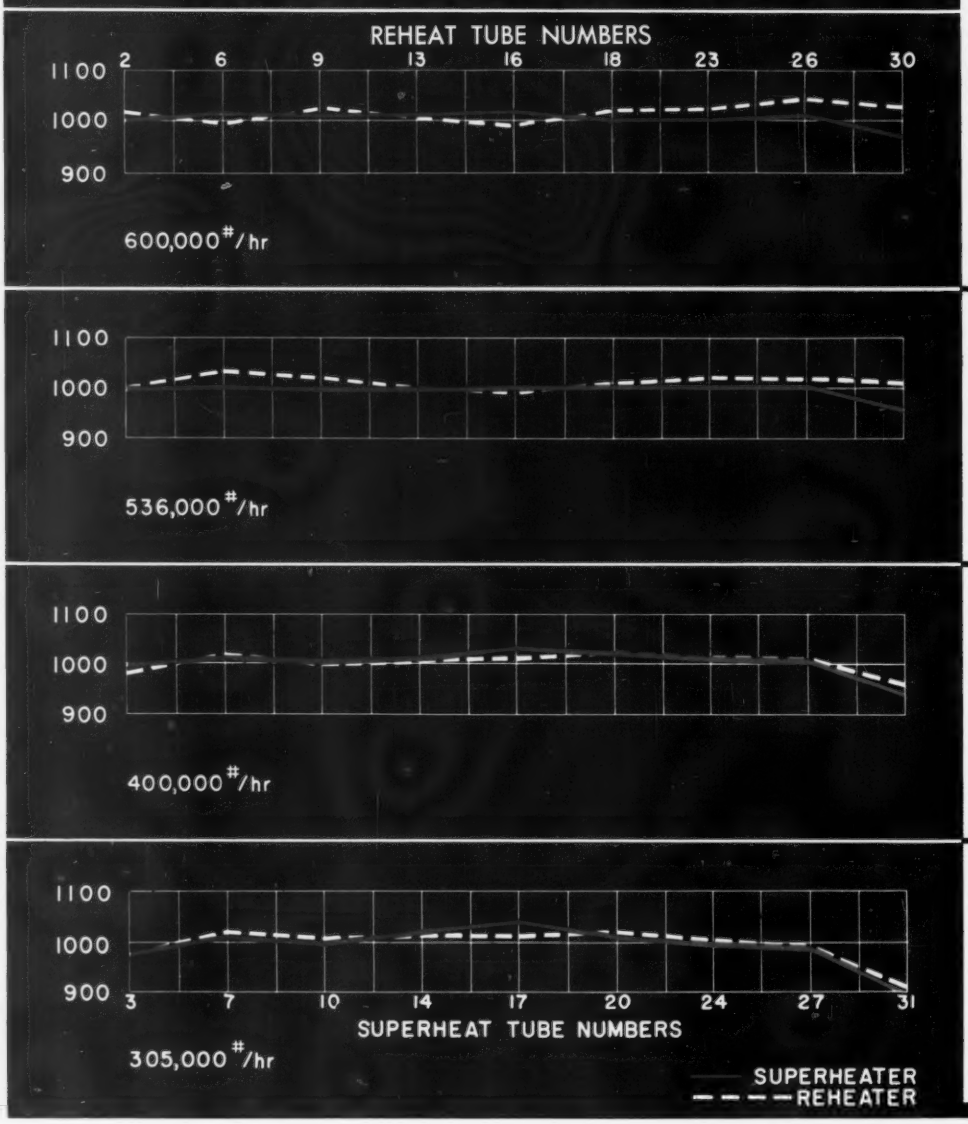
Design Pressure — 1750 psig
Superheat/Reheat — 1000° F
Fired by Natural Gas and Oil
Efficiency up to 90% on oil — 86% on gas.

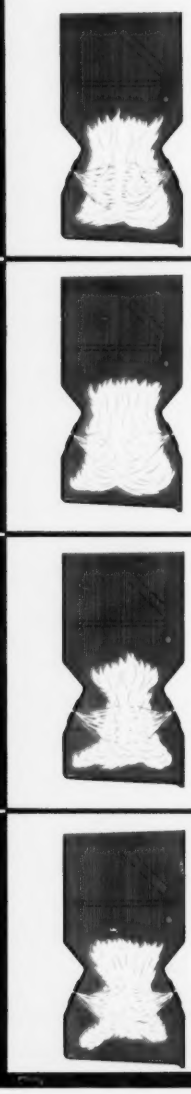
**BLACK & VEATCH**
**Consulting Engineers**



**FINAL SUPERHEAT-REHEAT EXIT TUBE TEMPERATURES**

**FLAME CONTOURS**



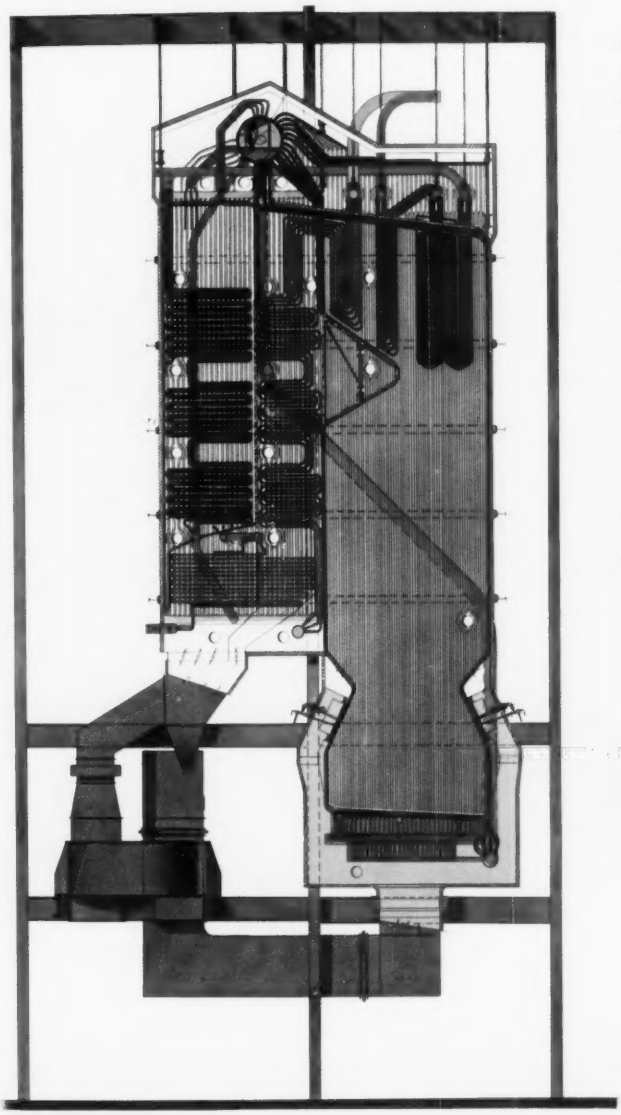



# RILEY TURBO FURNACE

## *produces extremely uniform furnace exit temperature at*

## *FLORIDA POWER CORPORATION*

**Uniform, safe gas temperatures across the full span of a boiler's high temperature superheater and reheater is a vital requirement for trouble-free operation. With a Riley Turbo Furnace this objective is attained . . . without use of costly auxiliary methods for distributing furnace gas.**



In the Riley Turbo Furnace all fuels — gas, oil, coal — are burned at the base of the furnace well away from superheater and reheater with combustion taking place evenly from side wall to side wall. Combustion gas rises within the furnace envelope in a uniform side wall to side wall column resulting in minimum variation in metal skin temperatures of all superheater and reheater elements. Temperatures are well within safe alloy limits to assure long tube life. Proof of such performance is provided in the accompanying curves. Flame contour diagrams illustrate combustion uniformity at each load level.

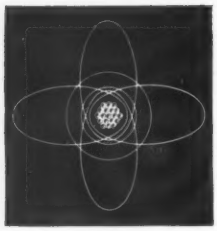
The Turbo Furnace boiler is capable of operating over a 6-1 load range with oil or gas firing with all burners in service on automatic control and without burner adjustment. Design and operating characteristics of the Turbo Furnace also provide more rapid and uniform water and steam circulation, help to maintain a clean furnace, and minimize flyash and air pollution problems.

# RILEY

STEAM GENERATING AND
FUEL BURNING EQUIPMENT

**RILEY STOKER CORPORATION**
WORCESTER, MASSACHUSETTS

**SALES OFFICES:**
Boston, Charlotte, Chicago, Cincinnati, Cleveland, Denver, Detroit, Honolulu, Houston, Jacksonville, Kansas City, Los Angeles, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Salt Lake City, San Francisco, St. Louis, St. Paul, Seattle, Syracuse.



# Nuclear notes

By B G A SKROTZKI, Associate Editor

**Organic-cooled nuclear-plant** prototype proposals, due July 24, 1961, have been invited by the AEC from Burlington (Vt.) Light Department; Grand River Dam Authority, Vinita, Okla.; Plains Electric Generation and Transmission Cooperative, Inc, Albuquerque, N.M. and Dairyland Power Cooperative, La Crosse, Wis. The 50-mwe plant should be running by winter 1964-'65, using an organic-cooled and -moderated reactor. It would be built under the AEC's power-demonstration-reactor program. Utility would provide site and facilities to run the entire plant for at least five years as part of its electric-power system. Reactor would be financed primarily by the AEC, and the utility would buy its steam. Atomics International is designing the nuclear-steam system and doing preconstruction research. Atomics International, Phillips Petroleum Co and California Research Corp are working on a solution for fuel-element fouling.

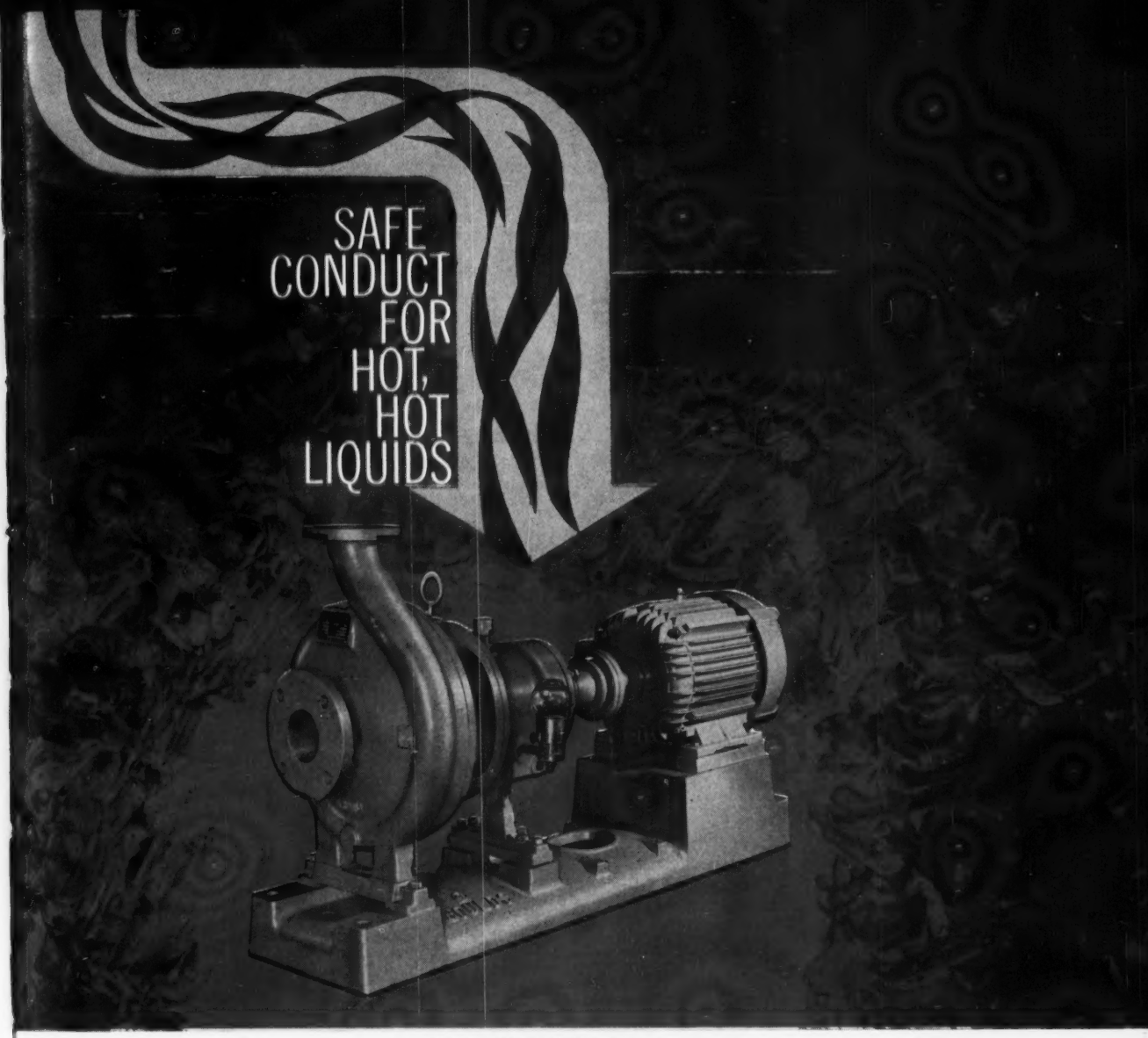
**Thousandfold progress** in fusion research has been achieved at Oak Ridge National Laboratory. They've managed to hold fast-circulating hydrogen ions in a magnetic field for three seconds, compared to an original few thousandths of a second. The ions are accelerated through 600,000 v in an evacuated porcelain tube and shot into a strong magnetic field between two large coils about three ft apart. Average trapping time of three seconds corresponds to about 45 million circulations of the protons in their orbits. Next step: increase the number of trapped ions some 10,000 times. We still have a long way to go to reach practical fusion power generation.

**Office of Industrial Participation** of the AEC will be headed by E B Tremmel, Director. The office will: (1) advise industry on opportunities for private participation and investment in atomic energy for civilian needs and for support of government programs (2) study industrial type activities by AEC operating contractors that could be done by private industry and recommend transfer of these activities to private industry when warranted (3) appraise AEC policies and plans for broadening industry's participation in the program.

**Losses on nuclear-plant contracts** for Babcock & Wilcox Ltd of England ran $1.8 million in 1960. In addition, about $2 million has been set aside to cover further losses. B&W has almost finished components for the Hinkley Point and Trawsfyndd nuclear power stations and must find work for its specialized plant until the new contract for the Sizewell Station reaches the shop floor toward the end of '61. Total income was $99.96 million last year. (*McGraw-Hill World News*)

**AEC means business** when it finds its regulations violated. It has ordered the University of Wyoming to shut down its reactor operations at once and hold the reactor locked out until further investigation. An inspector found the reactor running without a licensed operator in attendance.

**Speedup of nuclear program** is suggested by G T Seaborg, Chairman of AEC. He advocates capital-grant incentives, operating subsidies, reduction of charges for nuclear materials, fast tax write-off, financing long transmission lines to remote reactor plants. (*McGraw-Hill World News*)




Model 3195 centrifugal pump

# WHY THIS DUCTILE IRON PUMP HITS 500°F...WITHOUT RISK...WITH LESS COST

Now you can pump liquids as hot as 500° F, low-specific-gravity hydrocarbons and other tough services at working pressures to 275 PSIG without the extra cost of carbon steel.

Ductile Iron resists stress, impact and high pressure as much as carbon steel does—because it has properties similar to carbon steel's.

| | Tensile Strength | Yield Strength | Elon-gation | Notes |
|---|---|---|---|---|
| Cast Iron A48-56 | 30,000 PSI | 0 | 0 | |
| Goulds Ductile Iron (ASTM A395-56T) | 60,000 to 70,000 PSI | 45,000 to 50,000 PSI | 15-25% | As heat treated to full ferritized anneal |
| Carbon Steel ASTM A-216-59T-WCB | 70,000 PSI | 36,000 PSI | 22% | |

**3 Tests Prove Your Pump's Toughness.** Each heat of Ductile Iron goes through three rigorous tests—physical, chemical and microscopic.

We break and twist test bars to make sure tensile strength and elongation conform to ASTM-A395-56T specs. We run a chemical analysis to assure the right base chemistry. Microscopic analysis tests for spheroid structure of graphite and completeness of ferritization.

You can get information covering each heat and all castings poured from it. Or we can make tests to your specs.

There's a big story on the Goulds Model 3195, available "off the shelf" in Ductile Iron. Ductile Iron compares to carbon steel in ductility, impact resistance and resistance to thermal shock. Costs less. Both pumping units and pump parts are highly interchangeable. It's available in Ductile-Ni-Resist when corrosion is a factor. Bulletin 725.1 can fill you in with all the details—dimensional interchangeability, bearing frame selection chart, pressure-temperature chart and other helpful information.

Just write Goulds Pumps, Inc., Dept. PO-61, Seneca Falls, New York.

**GOULDS PUMPS**

**For more facts circle 246 on Reader Service card, p 121**

# Power's data sheet

No. 346

## Seamless carbon-steel pipe to ASTM Spec A-53 Grade A and Spec A-106 Grade A

| Pipe size, in. | Nom OD, in. | Wall thick, in. | Temperature, F: To 650 (Max allowable stress, psi: 12,000) | 700 (11,650) | 750 (10,700) | 775 (9850) |
|---|---|---|---|---|---|---|
| **Schedule 10** | | | | | | |
| 14 | 14 | .250 | 380 | 369 | 339 | 312 |
| 16 | 16 | .250 | 332 | 322 | 296 | 273 |
| 18 | 18 | .250 | 295 | 286 | 263 | 242 |
| 20 | 20 | .250 | 265 | 257 | 236 | 218 |
| 24 | 24 | .250 | 221 | 214 | 197 | 181 |
| **Schedule 20** | | | | | | |
| 8 | 8.625 | .250 | 622 | 604 | 555 | 511 |
| 10 | 10.75 | .250 | 497 | 483 | 443 | 408 |
| 12 | 12.75 | .250 | 418 | 406 | 373 | 343 |
| 14 | 14 | .312 | 475 | 462 | 424 | 390 |
| 16 | 16 | .312 | 415 | 403 | 370 | 341 |
| 18 | 18 | .312 | 328 | 358 | 329 | 302 |
| 20 | 20 | .375 | 399 | 387 | 356 | 327 |
| 24 | 24 | .375 | 332 | 322 | 296 | 272 |
| **Schedule 30** | | | | | | |
| 8 | 8.625 | .277 | 689 | 669 | 614 | 565 |
| 10 | 10.75 | .307 | 613 | 595 | 540 | 503 |
| 12 | 12.75 | .330 | 554 | 538 | 494 | 455 |
| 14 | 14 | .375 | 573 | 556 | 511 | 470 |
| 16 | 16 | .375 | 500 | 486 | 446 | 411 |
| 18 | 18 | .438 | 520 | 504 | 463 | 426 |
| 20 | 20 | .500 | 535 | 519 | 477 | 439 |
| 24 | 24 | .562 | 500 | 486 | 446 | 411 |
| **Schedule 40** | | | | | | |
| ½ | .84 | .109 | 882 | 857 | 787 | 724 |
| ¾ | 1.05 | .113 | 798 | 775 | 711 | 655 |
| 1 | 1.315 | .133 | 960 | 932 | 856 | 788 |
| 1¼ | 1.66 | .14 | 863 | 838 | 769 | 703 |
| 1½ | 1.90 | .145 | 804 | 781 | 717 | 660 |
| 2 | 2.375 | .154 | 724 | 703 | 646 | 594 |
| 2½ | 2.875 | .203 | 974 | 945 | 868 | 799 |
| 3 | 3.50 | .216 | 875 | 850 | 780 | 718 |
| 4 | 4.50 | .237 | 1146 | 1113 | 1022 | 941 |
| 5 | 5.563 | .258 | 1008 | 978 | 898 | 827 |
| 6 | 6.625 | .28 | 914 | 888 | 815 | 751 |
| 8 | 8.625 | .322 | 806 | 782 | 718 | 661 |
| 10 | 10.75 | .365 | 729 | 708 | 650 | 599 |
| 12 | 12.75 | .406 | 683 | 664 | 609 | 561 |
| 14 | 14 | .437 | 671 | 652 | 599 | 551 |
| 16 | 16 | .50 | 672 | 652 | 599 | 551 |
| 18 | 18 | .562 | 671 | 651 | 598 | 550 |
| 20 | 20 | .593 | 637 | 619 | 568 | 523 |
| 24 | 24 | .687 | 614 | 596 | 548 | 504 |
| **Schedule 60** | | | | | | |
| 8 | 8.625 | .406 | 1021 | 992 | 911 | 833 |
| 10 | 10.75 | .50 | 1011 | 981 | 901 | 830 |
| 12 | 12.75 | .562 | 956 | 928 | 852 | 784 |
| 14 | 14 | .593 | 919 | 892 | 819 | 754 |
| 16 | 16 | .656 | 886 | 861 | 790 | 728 |
| 18 | 18 | .750 | 901 | 875 | 803 | 739 |
| 20 | 20 | .812 | 878 | 853 | 783 | 721 |
| 24 | 24 | .968 | 873 | 847 | 778 | 716 |
| **Schedule 80** | | | | | | |
| ½ | .84 | .147 | 1947 | 1890 | 1736 | 1598 |
| ¾ | 1.05 | .154 | 1690 | 1641 | 1507 | 1387 |
| 1 | 1.315 | .179 | 1777 | 1725 | 1585 | 1459 |
| 1¼ | 1.66 | .191 | 1551 | 1506 | 1383 | 1273 |
| 1½ | 1.90 | .20 | 1457 | 1415 | 1299 | 1196 |
| 2 | 2.375 | .218 | 1329 | 1290 | 1185 | 1091 |
| 2½ | 2.875 | .276 | 1554 | 1508 | 1385 | 1275 |
| 3 | 3.50 | .30 | 1422 | 1381 | 1268 | 1167 |
| 4 | 4.50 | .337 | 1660 | 1612 | 1481 | 1363 |
| 5 | 5.563 | .375 | 1485 | 1441 | 1324 | 1219 |
| 6 | 6.625 | .432 | 1435 | 1393 | 1279 | 1178 |
| 8 | 8.625 | .50 | 1270 | 1233 | 1133 | 1043 |
| 10 | 10.75 | .593 | 1208 | 1172 | 1077 | 991 |
| 12 | 12.75 | .687 | 1178 | 1143 | 1050 | 967 |
| 14 | 14 | .75 | 1168 | 1134 | 1042 | 959 |
| 16 | 16 | .843 | 1151 | 1118 | 1026 | 945 |
| 18 | 18 | .937 | 1136 | 1103 | 1013 | 933 |
| 20 | 20 | 1.031 | 1123 | 1090 | 1001 | 922 |
| 24 | 24 | 1.218 | 1106 | 1074 | 987 | 908 |
| **Schedule 100** | | | | | | |
| 8 | 8.625 | .593 | 1520 | 1476 | 1356 | 1248 |
| 10 | 10.75 | .718 | 1473 | 1430 | 1314 | 1209 |
| 12 | 12.75 | .843 | 1459 | 1416 | 1301 | 1197 |
| 14 | 14 | .937 | 1477 | 1434 | 1317 | 1212 |
| 16 | 16 | 1.031 | 1417 | 1376 | 1263 | 1163 |
| 18 | 18 | 1.156 | 1413 | 1372 | 1260 | 1160 |
| 20 | 20 | 1.281 | 1408 | 1367 | 1256 | 1156 |
| 24 | 24 | 1.531 | 1403 | 1362 | 1251 | 1151 |

| Pipe size, in. | Nom OD, in. | Wall thick, in. | Temperature, F: To 650 (Max allowable stress, psi: 12,000) | 700 (11,650) | 750 (10,700) | 775 (9850) |
|---|---|---|---|---|---|---|
| **XX** | | | | | | |
| ½ | .84 | .294 | 6711 | 6516 | 5984 | 5509 |
| ¾ | 1.05 | .308 | 5553 | 5391 | 4951 | 4558 |
| 1 | 1.315 | .358 | 5326 | 5171 | 4749 | 4372 |
| 1¼ | 1.66 | .382 | 4468 | 4337 | 3984 | 3667 |
| 1½ | 1.90 | .400 | 4091 | 3972 | 3648 | 3358 |
| 2 | 2.375 | .436 | 3584 | 3480 | 3196 | 2942 |
| 2½ | 2.875 | .552 | 3947 | 3832 | 3520 | 3240 |
| 3 | 3.50 | .600 | 3525 | 3422 | 3143 | 2894 |
| 4 | 4.50 | .674 | 3515 | 3412 | 3134 | 2885 |
| 5 | 5.563 | .750 | 3124 | 3033 | 2786 | 2564 |
| 6 | 6.625 | .864 | 3014 | 2926 | 2687 | 2474 |
| 8 | 8.625 | .875 | 2294 | 2227 | 2045 | 1883 |
| **Schedule 120** | | | | | | |
| 4 | 4.50 | .438 | 2192 | 2128 | 1954 | 1799 |
| 5 | 5.563 | .50 | 2016 | 1957 | 1798 | 1655 |
| 6 | 6.625 | .562 | 1895 | 1839 | 1589 | 1555 |
| 8 | 8.625 | .718 | 1858 | 1804 | 1657 | 1525 |
| 10 | 10.75 | .843 | 1746 | 1695 | 1557 | 1433 |
| 12 | 12.75 | 1.00 | 1743 | 1692 | 1554 | 1430 |
| 14 | 14 | 1.093 | 1735 | 1685 | 1547 | 1424 |
| 16 | 16 | 1.218 | 1691 | 1641 | 1507 | 1388 |
| 18 | 18 | 1.375 | 1695 | 1645 | 1511 | 1391 |
| 20 | 20 | 1.50 | 1663 | 1614 | 1483 | 1365 |
| 24 | 24 | 1.812 | 1675 | 1626 | 1493 | 1375 |
| **Schedule 140** | | | | | | |
| 8 | 8.625 | .812 | 2118 | 2056 | 1888 | 1738 |
| 10 | 10.75 | 1.00 | 2090 | 2029 | 1863 | 1715 |
| 12 | 12.75 | 1.125 | 1974 | 1916 | 1760 | 1620 |
| 14 | 14 | 1.25 | 2000 | 1942 | 1784 | 1642 |
| 16 | 16 | 1.438 | 2014 | 1955 | 1796 | 1653 |
| 18 | 18 | 1.562 | 1940 | 1884 | 1730 | 1593 |
| 20 | 20 | 1.75 | 1957 | 1900 | 1745 | 1606 |
| 24 | 24 | 2.062 | 1919 | 1863 | 1711 | 1575 |
| **Schedule 160** | | | | | | |
| ½ | .84 | .187 | 3158 | 3066 | 2316 | 2592 |
| ¾ | 1.05 | .218 | 3214 | 3120 | 2860 | 2638 |
| 1 | 1.315 | .25 | 3098 | 3008 | 2763 | 2543 |
| 1¼ | 1.66 | .25 | 2405 | 2335 | 2144 | 1974 |
| 1½ | 1.90 | .281 | 2475 | 2403 | 2207 | 2031 |
| 2 | 2.375 | .343 | 2590 | 2514 | 2309 | 2126 |
| 2½ | 2.875 | .375 | 2368 | 2299 | 2111 | 1944 |
| 3 | 3.50 | .438 | 2352 | 2283 | 2097 | 1930 |
| 4 | 4.50 | .531 | 2703 | 2624 | 2410 | 2219 |
| 5 | 5.563 | .625 | 2561 | 2486 | 2283 | 2102 |
| 6 | 6.625 | .718 | 2466 | 2394 | 2198 | 2024 |
| 8 | 8.625 | .906 | 2381 | 2312 | 2123 | 1955 |
| 10 | 10.75 | 1.125 | 2371 | 2301 | 2114 | 1946 |
| 12 | 12.75 | 1.312 | 2329 | 2261 | 2076 | 1912 |
| 14 | 14 | 1.406 | 2268 | 2202 | 2022 | 1862 |
| 16 | 16 | 1.593 | 2249 | 2184 | 2006 | 1846 |
| 18 | 18 | 1.781 | 2232 | 2167 | 1990 | 1832 |
| 20 | 20 | 1.968 | 2221 | 2156 | 1980 | 1823 |
| 24 | 24 | 2.343 | 2201 | 2137 | 1963 | 1807 |

**NOTES:**
Maximum allowable working pressures are based on this formula:

$$P = \frac{S}{\frac{1}{2}\left(\frac{D}{tm - C}\right) - y}$$

Where: $y = 0.4$ for ferritic steels at 900 F or below
$C = 0.065$ for ½- to 3-in. pipe and 0.000 for 4-in. or larger pipe

## Maximum allowable working pressure-1

Starting with this month's *Data Sheet*, we are updating the working-pressure tables given in *Data Sheets 306* through *311*, February through July, 1958.

Figures in body of table are pressures, psi, for given temperatures and pipe sizes. These are based on American Standard Code for Pressure Piping, ASA B31.1-1955, with a modification of *C* values as shown above to reflect current practice. Expected revisions to B31 will bring Code in line with tables in this series.

GEORGE C HALZEL, *Boston, Mass.*

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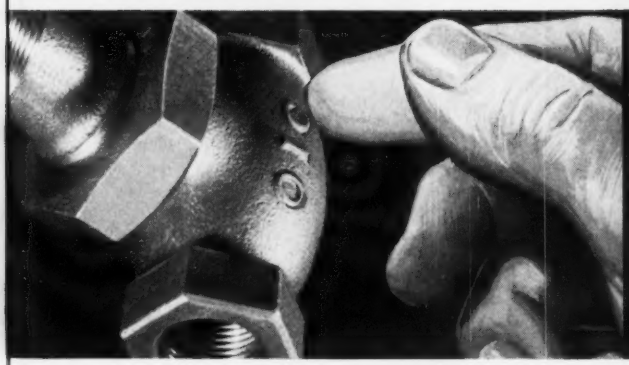

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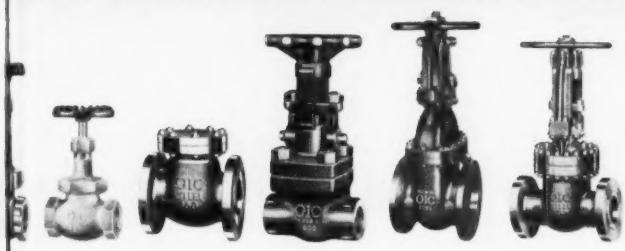

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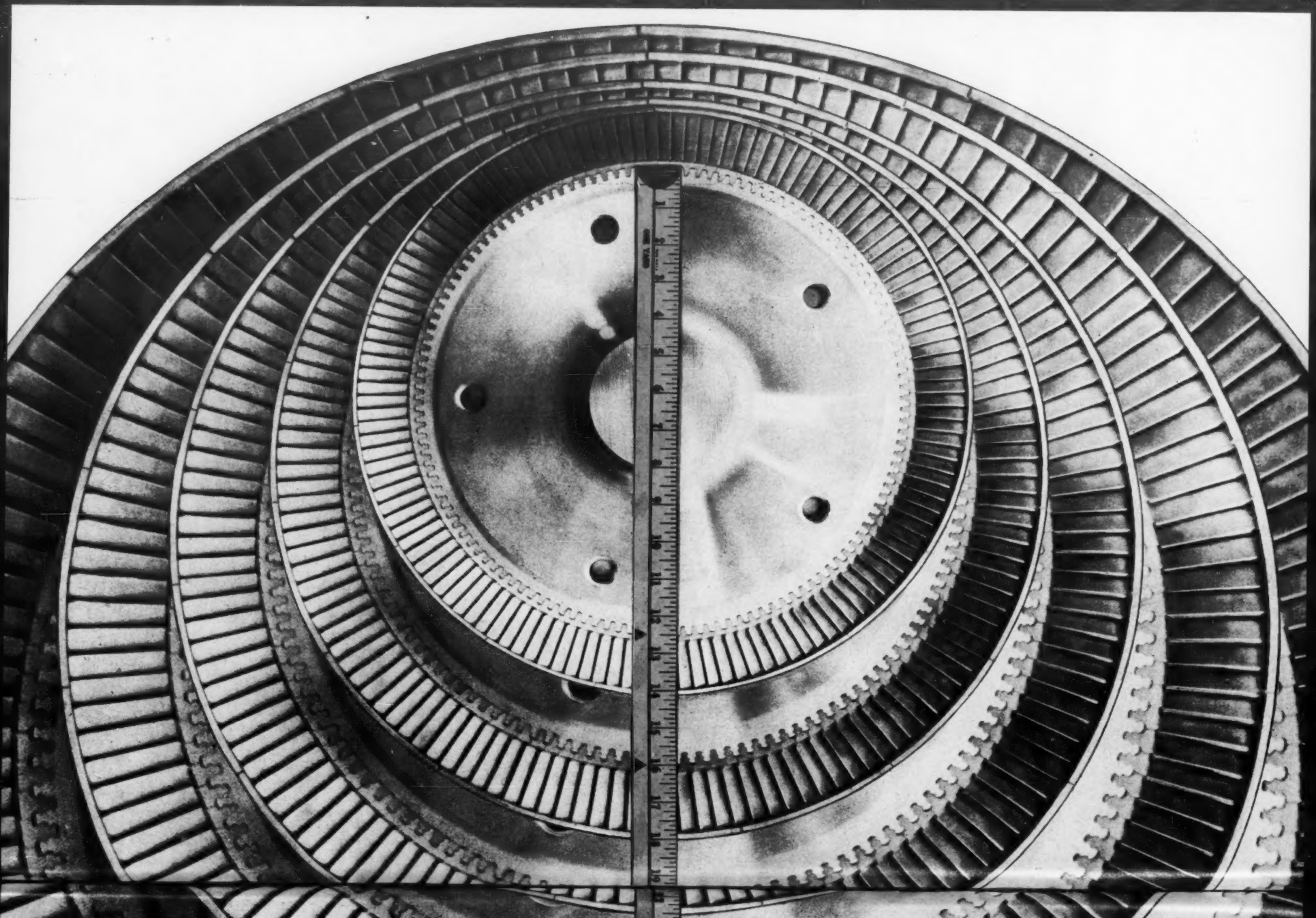

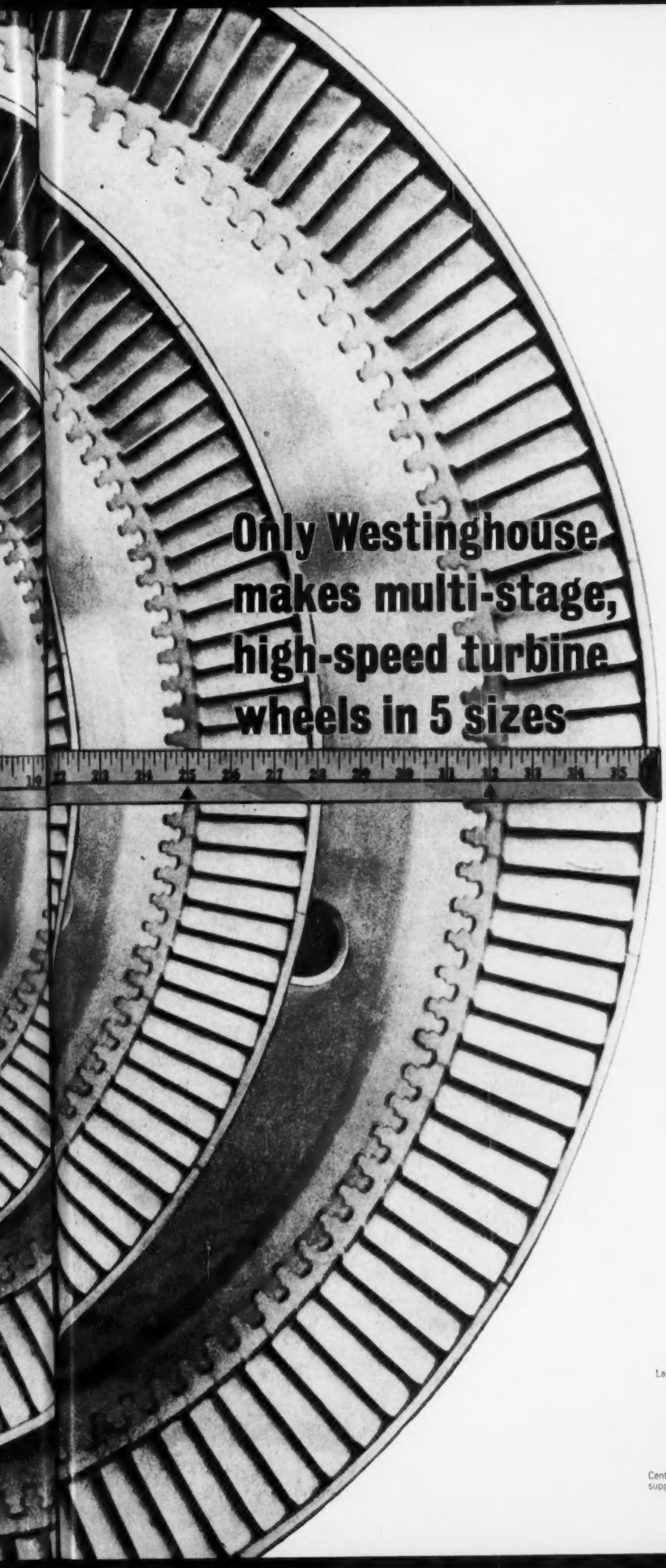


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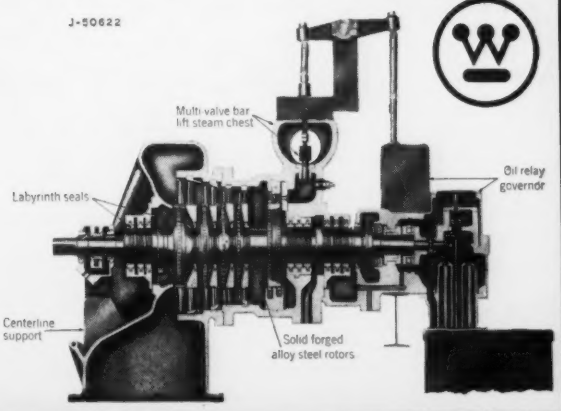

*(Advertisement)*

# Some Straight Talk On Steam Trap Capacity

## ...or pulling away the curtain of confusion that surrounds steam trap capacity ratings.

Unfortunately, for the steam trap buyer, the subject of steam trap capacity has become cloudy and confused by a landslide of claims, counter-claims and inconsistent "standards" for measurement. So let's take a cold hard look at this subject so vital to the efficient operation of your plant.

### What Determines Steam Trap Capacity?

There are three factors that determine the capacity of a steam trap:

1. The area of the orifice.
2. The density of the condensate.
3. The pressure differential across the trap.

Let's take a closer look at each of these:

*Area of orifice* is usually specified by the trap manufacturer or can be calculated from the diameter. Nothing complicated here.

*Density of condensate* depends on temperature. A cubic foot of cold water weighs 62.4 lbs. At 250° F. or 15 psi, it weighs less than 59 lbs. This is important. Don't overlook it.

*Pressure differential across the trap* is most significant. And it is complicated by the many factors that affect it, such as:

1. Pressure drop between unit drained and the trap when the trap valve is open.

2. Distance the trap valve is moved from the valve seat.

3. Back pressure on the trap with orifice closed; i.e., return header pressure.

4. Increase in back pressure produced by condensate and flash steam flowing in the discharge line. This in turn is affected by the diameter and length of the discharge line, plus friction caused by valves and fittings.

### Orifice Capacity Vs. Steam Trap Capacity

Figure 1 shows a ½" diameter sharp-edged orifice at the end of a pipe filled with cold water at 15 lbs. pressure. The capacity of this orifice, using a .61 coefficient of flow would be 8,800 lbs. per hr. Now, would this ½" orifice if used in a ¾" steam trap installed as shown in Figure 2 provide the trap with a continuous discharge capacity of 8,800 lbs. of hot condensate per hour? The answer is "no". And here are some of the reasons why:

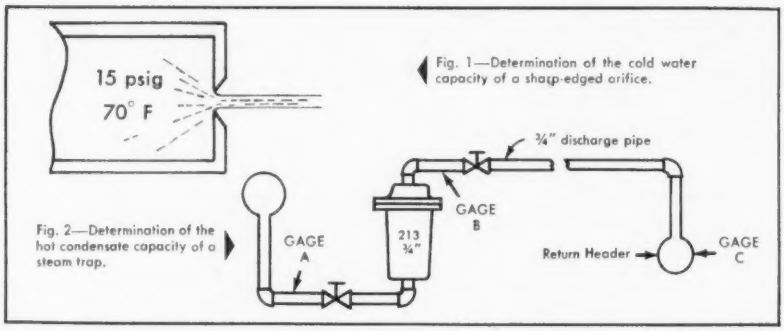


Fig. 1—Determination of the cold water capacity of a sharp-edged orifice.

Fig. 2—Determination of the hot condensate capacity of a steam trap.

*Density of condensate.* As pointed out above, cold water weighs 62.4 lbs. per cu. ft. At 15 lbs. pressure and 250° F. water weighs less than 59 lbs. per cu. ft. This difference in density alone reduces the lbs. per hour capacity of the orifice by over 5%.

*Pressure differential across the trap.* With the trap valve closed we have a static pressure differential of 15 psi. The trap valve must be able to open against this pressure. However, this is not the pressure differential that will determine the capacity of the trap valve.

The ¾" discharge line will be full of a mixture of flash steam and condensate. To keep this mixture flowing from the trap outlet to the return line requires a pressure differential. In actual capacity tests run as shown in Figure 2 Gage B at the trap outlet registered 11 lbs. back pressure. Thus the true pressure differential across the trap was about 4 lbs. Under these conditions the measured capacity of the trap was 4,340 lbs/hr. or just about half of the capacity of the ½" orifice for cold water.

### How Armstrong Determines Capacity Ratings

Armstrong trap capacity ratings are based on hundreds of tests under actual operating conditions. In these tests, the condensate used was at the steam temperature corresponding to the test pressure. Thus, the capacities determined take into account the pressure drop that occurs when the trap orifice opens and the choking effect and back pressure of the flash steam. Actual installation hook-ups were used so that pipe friction in both inlet and discharge lines as well was reflected in the results.

Let's go back to the example cited above and in Figure 2. The trap referred to is an Armstrong No. 213. While it did test out at 4,340 lbs. per hour for a static pressure differential of 15 psi, it is rated in the catalog at only 3900 lbs. per hour for this pressure—just to be on the safe side.

For the trap buyer, this means that Armstrong Steam Trap capacities are based on handling condensate at steam temperature for the stated static steam pressure differential under actual working conditions.

Capacity ratings which don't take into account all of the variables will be misleading and may lead to the selection of undersized traps. So whenever you specify or buy traps be sure that the capacity ratings you work from are realistic. One way to be sure is to select Armstrong Traps with *guaranteed* capacity ratings.

* * *

Additional information on trap capacity ratings, plus data on how to correctly size, install and maintain steam traps for any pressure, any temperature and any load, are presented in the 48-page Armstrong Steam Trap Book. Ask your local Armstrong Representative for a copy or write:

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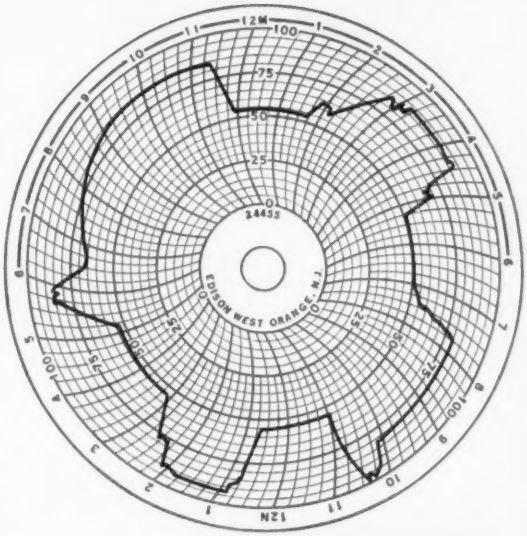


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# Technical briefs . . . A world-wide look at

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## Annual NACE Conference hits broad spectrum of corrosion and materials problems

**Shot peening for protection against stress-corrosion cracking.** *H Suss, General Electric Co*
Properly applied shot peening will protect AISI-410 stainless steel against stress corrosion by creating a compressive layer on the metal surface. At 300 F this protection holds for a useful period at stresses up to 60,000 psi, continues indefinitely at 45,000 psi.

Piece to be protected must be specifically designed for shot peening and actual process must be closely controlled. Shot-peening stresses can be erased by high temperatures. For ordinary spring steels, temperatures less than 500 F have no effect. Above 500 F residual stresses are partially relieved until they are almost completely gone at 800 F. Compressive stresses for stainless steels start to be relieved at about 1050 or 1100 F.

Shot size and intensity must produce adequate compressive surface layer but should not: (1) significantly affect surface finish (2) cause significant distortion beyond allowable dimensional tolerances (3) cause shot to imbed so far in the metal surface that it cannot be removed practically by vapor blasting. *NACE*

**Commercial hot-dip galvanizing of fabricated items used in construction of industrial projects,** *R Vickers, Nowery J Smith Company*
Fundamental steps of hot-dip galvanizing are covered and general composition of alloying layers in commercial galvanizing explained. Costs of galvanizing and other types of coatings—organic and inorganic—are compared; case histories show why some structures outlast others. Also given: aids for designing materials to be galvanized. *NACE*

**Plastic pipe systems for corrosion resistance,** *R W Johnson and A E Webb, Chemtrol, Santa Ana, Calif.*
Plastic pipe is no longer an interesting material with a promising future; it has racked up a long history in corrosive industrial services both here and abroad. This background of experience permits sound engineering decisions.

Increased use is based on: (1) excellent chemical resistance (2) external as well as internal noncorrosion (3) low friction losses (4) low installed cost and ease of maintenance (5) elimination of electrolysis (6) and good insulation qualities. Limitations do exist, however. It is not suitable for temperatures above 250 F, pressures above 150 to 230 psig or areas subject to physical abuse.

The more important thermoplastic-piping materials are listed together with their characteristics, advantages and disadvantages. Usual fitting and valve practice is detailed. A few case histories complete the picture. *NACE*

**Electrochemical theory of cavitation damage,** *H S Preiser, U.S. Navy Bureau of Ships*
Literature on cavitation damage is reviewed in an effort to arrive at a unified explanation of the damage mechanism. Then the prevailing mechanical theory is modified by an electrochemical mechanism to correlate behavior under varying cavitation intensities and fluid environments.

Details of tests illustrate the role of cathodic protection in changing damage rates. Recommendations for future research are given. *NACE*

**Evaluation of rigid plastics for chemical service,** *L S VanDelinder, Union Carbide Chemicals Co*
Investigation revealed the most suitable means of determining environmental effects on rigid plastics: hardness testing before and after exposure. On this basis, PVC, epoxy, phenolic, polyester, diepoxy and chlorinated polyether are discussed. Tests covered 1-, 3- and 6-month exposures in 26 chemicals. Additional testing included weight, dimensional and hardness change and flexural strength, yield and modulus. *NACE*

**Effect of mineral impurities in water on corrosion of aluminum and steel,** *L C Rowe, M S Walker, General Motors Company*
Laboratory study determined effect of single and mixed impurities on aluminum and steel corrosion. Corrosion-rate variations were determined by the conductance technique—based on corrosion of thin metal strips and its effect on electrical conductivity.

Tests covered chloride, sulfate, bicarbonate, carbonate, calcium, magnesium and silicate. Chloride and sulfate were active with steel, but no single impurity affected aluminum corrosion to the degree experienced with mixed impurities.

Soluble salts of copper, chloride and bicarbonate accelerated corrosion rate of aluminum. Pitting depended on concentration and temperature. *NACE*

**Iron sulfate for condenser-tube corrosion control,** *T W Bostwick, City of Jacksonville, Fla.*
In an effort to increase condenser-tube life, a thin film of $Fe_2O_3$ was plated out by twice-daily injections of 1 ppm of ferrous sulfate for 30-min periods.

# progress in energy-systems engineering

No chlorine was used during the 6-month test period, but heat-transfer rates were not seriously affected.

Tests were successful in that a sharp reduction in tube failures was noted. Conclusion: use of ferrous sulfate on an intermittent or batch basis will protect tubes at lower cost. And chlorination can be continued as necessary to maintain desired heat-transfer-rate level. *NACE*

**The use of differential thermal analysis in exploring minimum temperature limits of oil-ash corrosion,** *N D Phillips and C L Wagoner, The Babcock & Wilcox Company*

Investigation of oil-ash corrosion products (by differential thermal analysis) revealed lower solidification than melting temperatures. In fact, an ash composition was found which can be liquid and probably corrosive at 895 F metal temperatures.

Apparatus used for analysis is described, results with a variety of vanadium compounds tabulated.

Tests with a magnesium-oxide additive revealed that a reaction on heating occurred between 1160 and 1210 F. Resulting product melted at 2100 F. On cooling, it also solidified at 2100 F with no indication of any low-temperature phases. *NACE*

## Water treatment

**Considerations regarding demineralization and flash evaporation of high-pressure boiler makeup water,** *M E Gilwood and J G Mack, Pfaudler Permutit Inc*

Comparison of demineralization vs flash evaporation in large high-pressure steam-generating plants is made on grounds of (1) water quality (2) reliability (3) economics (4) labor (5) maintenance and (6) corrosion—to name but a few.

Economic comparison showed equipment-cost advantage for demineralizer with waters having over 1300-ppm total electrolytes (as $CaCO_3$). Total annual cost advantage for demineralizer starts at about 500-ppm total electrolytes—both figures based on 20,000-lb-per-hr unit capacity.

Demineralizer's additional advantage: improved heat rate and availability of high-quality water for plant startup. *APC*

**Operation of the sea-water-distillation pilot plant—Mandalay Steam Station,** *R E Whistler, Southern California Edison Company*

A flash-evaporation sea-water-distillation unit in 22 stages was installed at the Mandalay Steam Station as a sea-water-conversion pilot plant. Initial steam at 40 psig comes from the fifth stage of the turbine-generator. Evaporator tubes and tube sheets are made of copper alloy, water boxes of cast iron.

Test program divided into three stages: (1) short-time operation at each of several design conditions —once-through and recirculation operation at same two temperatures, 175 and 195 F, each with high and low capacity (2) longer-term operation at each design condition to determine optimum (3) operation at one optimum condition to come up with accurate cost data. These steps went off as planned.

Performance-test data is tabulated. It shows economy in lb of distillate per 1000 Btu at each condition. For once-through operation at 175 F with chemical feed, total costs run $1.92 per 1000 gal.

Details of chemical feed, acid cleaning and corrosion are given. Experimental work to date indicates that a similar 10-mgd plant might drop water costs to $1.00 per 1000 gal. *APC*

**A new method for increasing the sensitivity of the conductivity measurement of steam purity,** *R W Lane, C H Neff, T E Larson, Illinois State Water Survey*

Progress over recent years in conductivity method of determining steam purity is reviewed. To meet needs of newer internal boiler-water-treatment methods, pH-conductivity relationships of the ammonia-carbon-dioxide system at both 25 and 100 C are given. Report stresses increased sensitivity obtained by recording the conductivity at 100 C.

Application of this conductivity data to the calculation of dissolved solids in carryover is demonstrated in several specific plants. *APC*

## Electrical testing

**An analysis of errors in the calibration of electrical instruments,** *F L Hermach, National Bureau of Standards*

Traditionally, standards and equipment used to calibrate an electrical instrument have had to be ten times as accurate as the instrument being tested. And there are three classifications of errors and uncertainties that must be recognized in any calibration procedure: (1) systematic errors (constant or slowly varying during the measurement) (2) mistakes and blunders (3) incorrect methods and procedures. Each needs different handling.

Each of these errors and uncertainties is discussed in detail. In many cases the arbitrary 10-to-1 ratio can be reduced to 3-to-1 if each standard is calibrated periodically and the corrections applied when the standard is used to calibrate other instruments.

Three specific examples illustrate proper calibration techniques. *AIEE CP 61-63*

continued

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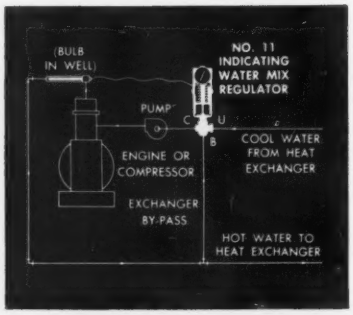
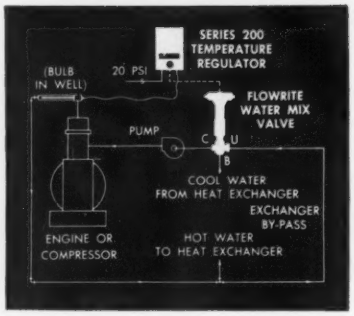
**For economy and simplicity –**

Install indicating water mix temperature regulator so that heat exchanger by-pass is connected to bottom port. Connect cool water from exchanger to upper port and pump suction to common port. Locate thermal bulb of regulator in warmed water outlet of engine or compressor. Use of a separable well permits bulb removal without draining system.




**For remote location of temperature regulator –**

Install water mix valves so that heat exchanger by-pass is connected to upper port, cool water to bottom port and pump to common port. Locate temperature regulator where convenient. Thermal bulb and well procedure is same as system above. Use of a reverse-acting temperature regulator prevents engine overheating in event of compressed air failure.




Request Powers *Engineer's Manual, Steam-Water Service* for full details and description of components. Free to anyone engaged in steam and water service, this manual gives the "how and what" for all types of systems and controls. You'll find it a practical, easy to follow guide for recommending or laying out new installations or updating old ones.

The coupon above is for your convenience. If you have an individual requirement or problem, send us the specifics. We'll advise on how best to handle it.

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**THE POWERS REGULATOR COMPANY**
Dept. 661, Skokie 24, Illinois

*In Canada: The Powers Regulator Co. of Canada Ltd. Downsview, Ontario*


## Technical briefs

Begins on page 112

**Controlled temperature and insulation protection in the operation of power transformers,** *F B Grace, Westinghouse Electric Corporation*

In May 1943, 14 small power transformers started service tests under cyclic loading conditions. They were identical except that oil-protection type differed for each. Later two more were added to the test group. So far, three interim papers have been presented *(AIEE 49-193, 52-88* and *56-89)*.

Electrical and mechanical tests and physical inspection were part of the program. Photographic records were maintained throughout test life.

Final test results are presented in tabular form. Data includes insulation power factor, oil power factor, total acids, oil breakdown and tensile strength of conductor insulation. *AIEE 61-39*

**Investigation of maintenance tests for generator insulation,** *C A Duke, L E Smith, C A Roberts, Tennessee Valley Authority and A W W Cameron, Hydro-Electric Power Commission of Ontario*

A large waterwheel-generator winding, about to be replaced, was used as a test specimen in an exhaustive series of insulation tests. Built in 1943, it was rated at 35,555 kva, 13.8 kv, 3 phase, 60 cycle, 105.8 rpm.

Included in the test objectives: assessing the reliability and accuracy with which dc strength of the insulation could be nondestructively indicated by current measurements at increasing direct voltages. After repeated and protracted exposure, no damage could be detected by dc-leakage or 60-c power-factor tests or physical dissection.

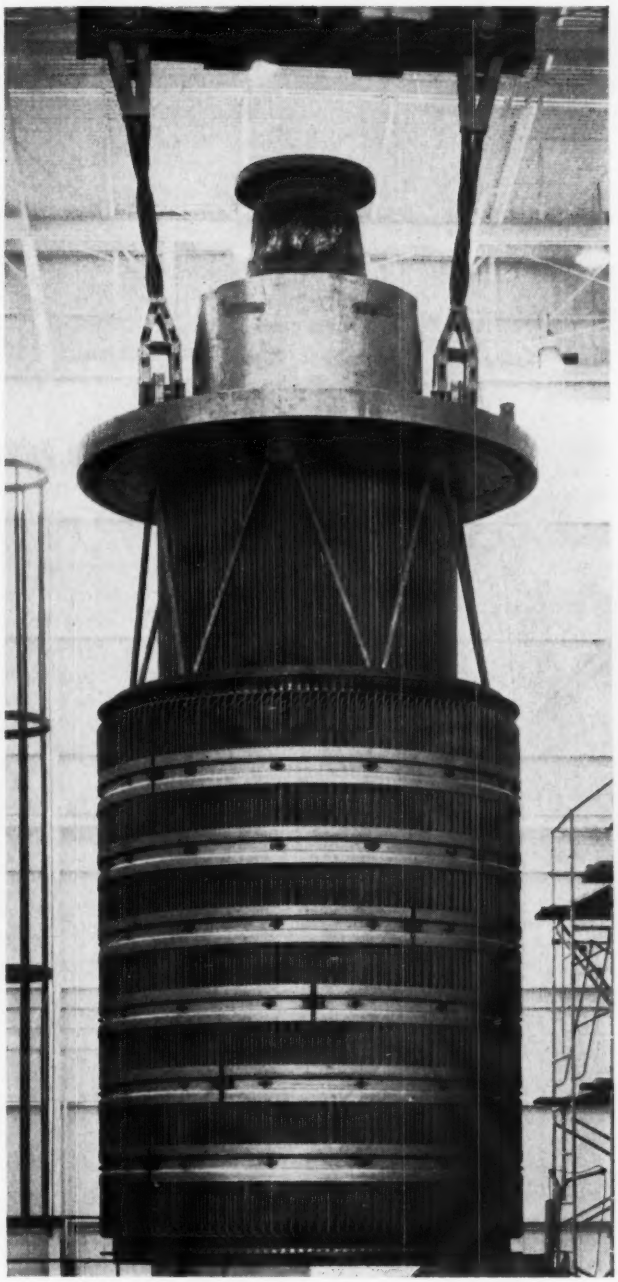
Many other tests and their results are discussed in detail. *AIEE 61-141*

## Nuclear energy

**Russian nuclear - energy - report** *translations available from OTS*

Controlled - thermonuclear - research programs in Russia appear to match similar research in the U.S. But economically competitive nuclear-power systems for Soviet industry seem

# TOMORROW'S POWER



**and**

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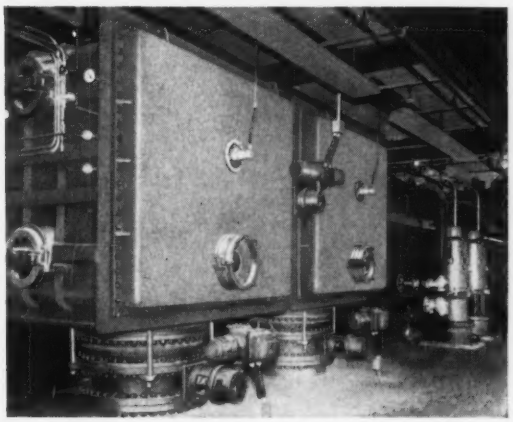
**COMBINED INGENUITY**

**AND SKILL BUILT IT.**

Three identical Griscom-Russell Vertical Once-Through Involute Tube, Liquid Sodium Heated Steam Generators (one of which is shown here)—have been installed and are being tested at the Enrico Fermi Power Plant built by the Power Reactor Development Corporation. These generators—first of their kind ever built—are an important break-through in the continuing efforts to produce steam from nuclear power more economically.



This 50,000 sq. ft. C. H. Wheeler Condenser at the new Indian River Plant of the Orlando (Florida) Utilities Commission, serves the 78,500 (rated capacity) turbine-generator. Its special deaerating features saved money in installation costs. C. H. Wheeler Ejectors, Circulators and the Condensate Pumps shown at the right also serve this new plant.

**GRISCOM-RUSSELL** / **C. H. WHEELER**

Massillon, Ohio — Philadelphia 32, Pa.

From this combined source you may now select condensers, circulating, condensate and general service pumps, steam jet ejectors, feedwater heaters, evaporators, generator gas coolers, tank heaters, heat exchangers, or special steam generators . . . all engineered and coordinated to meet the performance and space requirements of your power station.



For more facts circle 252 on Reader Service card, p 121

# CORROSION
## COSTS LESS TO STOP THAN IGNORE

Schaub Deaerators make corrosion more unnecessary than ever. Guaranteed to remove oxygen down to .005 cc/liter (Zero-Oxygen type), Schaub Deaerators stop the deadly corrosive action of oxygen in raw water which spells the early and costly replacement of boilers and lines. Your equipment will last longer and you'll get improved operating efficiency to boot!

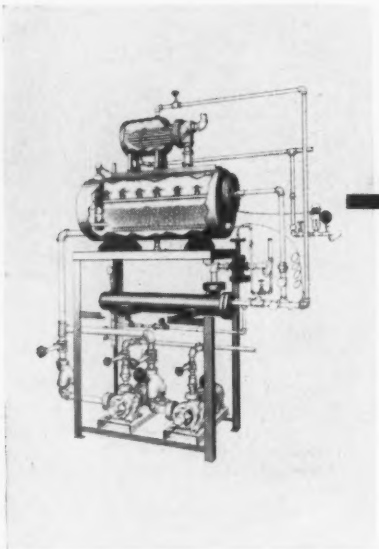
**SCHAUB DEAERATORS**

*guaranteed corrosion protection for any size plant*

All Schaub Deaerators operate *fully vented* at atmospheric pressure for complete release of all air — without expensive pressure vessel construction. ".03" type uses exclusive Schaub spray-contact vent condensing method to stop wasteful steam vapor loss. Pinpoint temperature control and "live-action" heating insure highest-efficiency operation regardless of load variations.

Schaub Deaerators bring truly effective low-cost corrosion protection within the reach of *any* plant . . . make it more expensive to ignore corrosion than to stop it.

*Write today for full information.*



**SCHAUB ZERO-OXYGEN DEAERATING SYSTEMS**—(illustrated) for capacities to 250,000 lbs./hr., are **guaranteed** for .005 cc/liter oxygen removal over a 10 to 1 load swing—**without** sodium sulphite. Features Schaub explosive flashdown and fully vented operation.

**SCHAUB ".03" DEAERATING SYSTEMS**—for the small to medium size plant in the 3,000 to 100,000 lbs./hr. range. **Guaranteed** oxygen removal down to .03 cc/liter under even widely varying load conditions. Fully vented operation.

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doubtful for a number of years. This estimate is contained in translations of Russian nuclear-energy literature.

These reports assess Soviet capabilities in controlled thermonuclear research and present a general survey of Russian advances in this field. Six translations are available:

**Controlled thermonuclear research in the U.S.S.R.** *(60-21925)*, July 1959, 44 pp, $1.75

**Evaluation of the irradiation reaction of the organism in the determination of the dose absorbed in integral units** *(61-(11084)*, 5 pp, 50¢. From *Vestnik Rentgenologii i Radiologii*, Vol 35, No. 4, July-Aug 1960

**Theory of nuclear breakup** *(61-11514)*, 11 pp, 50¢. From *Zhurnal Eksperimental'noy i Teoreticheskoy Fiziki*, Vol 10, No. 8, 1940

**Indium-gallium radiation circuit of the nuclear reactor IRT** *(60-21593)*, 10 pp, 50¢. From a paper by A K Breger, Warsaw, Sept 1959

**Recombination of the hydrogen atom in an adsorbed layer** *(60-41586)*, 28 pp, 75¢. From *Zhurnal Fizicheskoy Khimii*, Vol 8, No. 3, 1936

**Effect of oxygen in ionizing radiation** *(61-11109)*, 157 pp, $2.75, 1959

### To obtain complete text

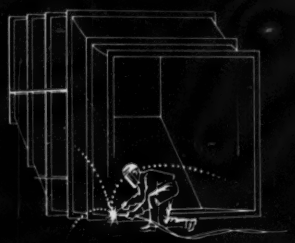
Material for these abstracts comes from the following sources. Order complete publication from source, *not* POWER.

*NACE*. Reprints will be available after publication in *Corrosion*. Contact National Association of Corrosion Engineers, 1061 M & M Building, Houston 2, Texas. Prices not established.

*APC*. To be published in book form. Contact American Power Conference, Illinois Institute of Technology, Technology Center, Chicago 16, Ill. $8.00.

*AIEE*. Contact American Institute of Electrical Engineers, 33 W 39th St, New York 18, N.Y. Members, 50¢; nonmembers, $1.00.

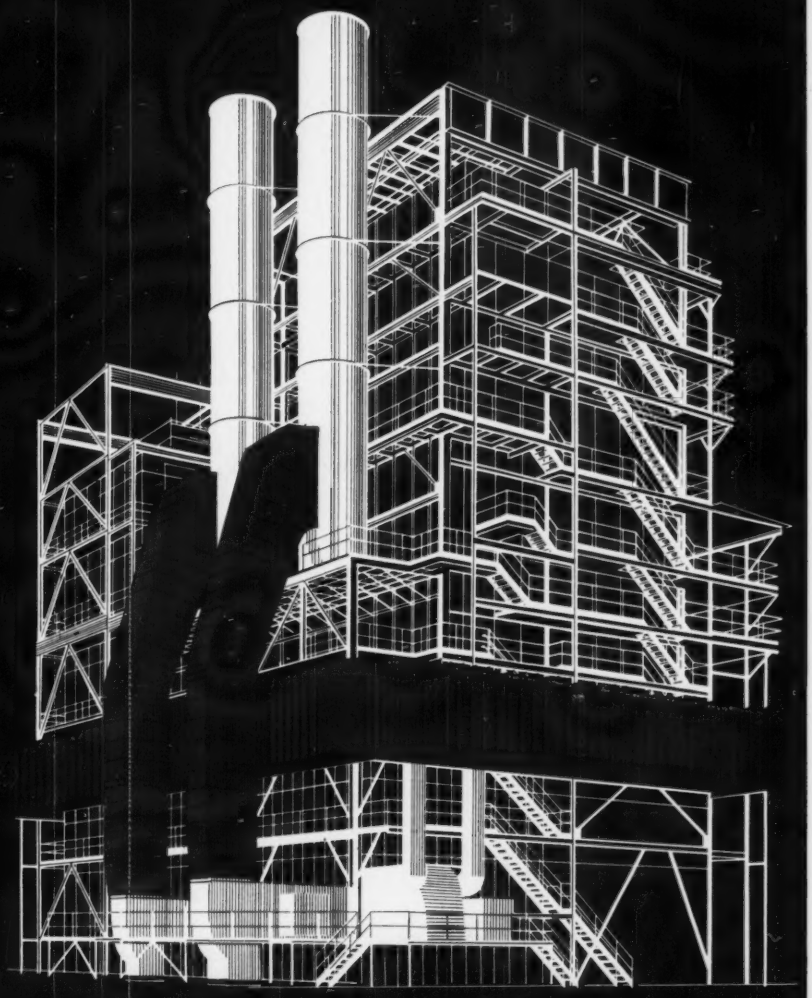
*OTS*. Contact Office of Technical Services, U.S. Dept of Commerce, Washington 25, D.C.



Breeching panels are factory prefabricated and/or pre-insulated; match-marked for shipment.

DeVilbiss combines insulation and lagging into a prefabricated panel, reducing insulation costs.

Experienced DeVilbiss crews are available to handle complete job-site assembly and erection.



**pre-insulated breeching** is a new concept pioneered by DeVilbiss' Metal Fabricators Division. It means prefabricating lagging and insulation in a single operation at the factory. Benefits to you: substantial reduction of field-insulation costs, reduced corrosion, increased thermal efficiency. Specialists work with you, from blueprint detailing to erection in your plant.

**Talk to DeVilbiss about all your power-plant breeching requirements**

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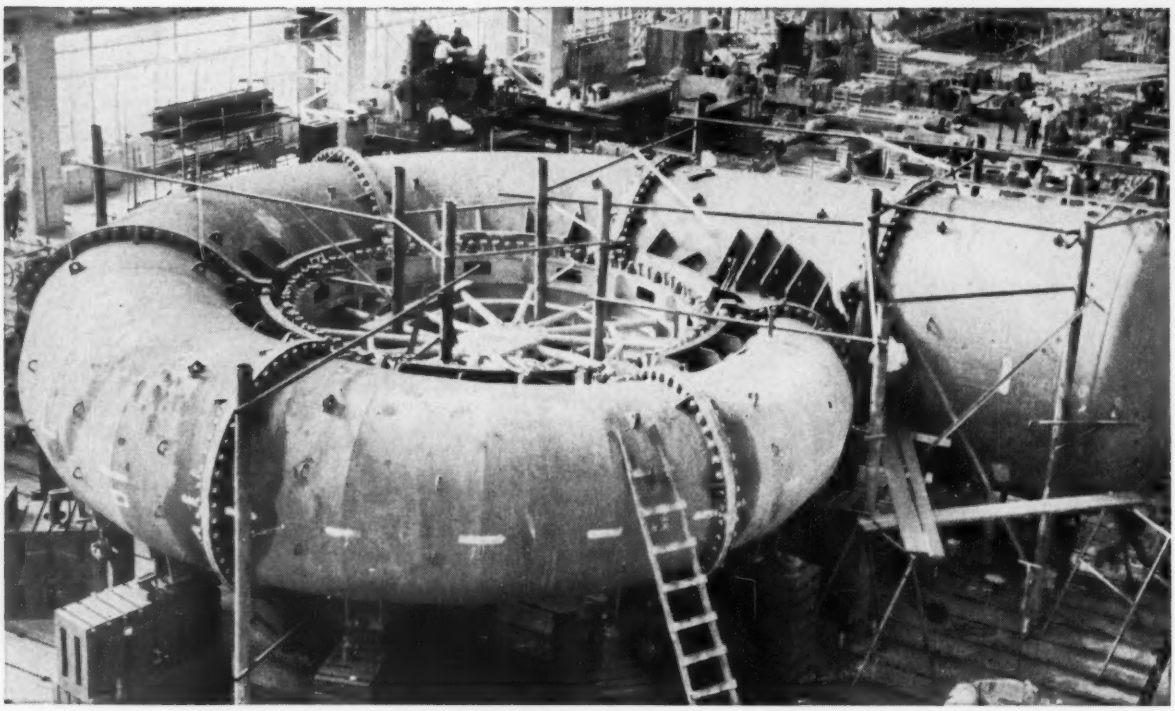
For more facts circle 254 on Reader Service card, p 121

# HITACHI

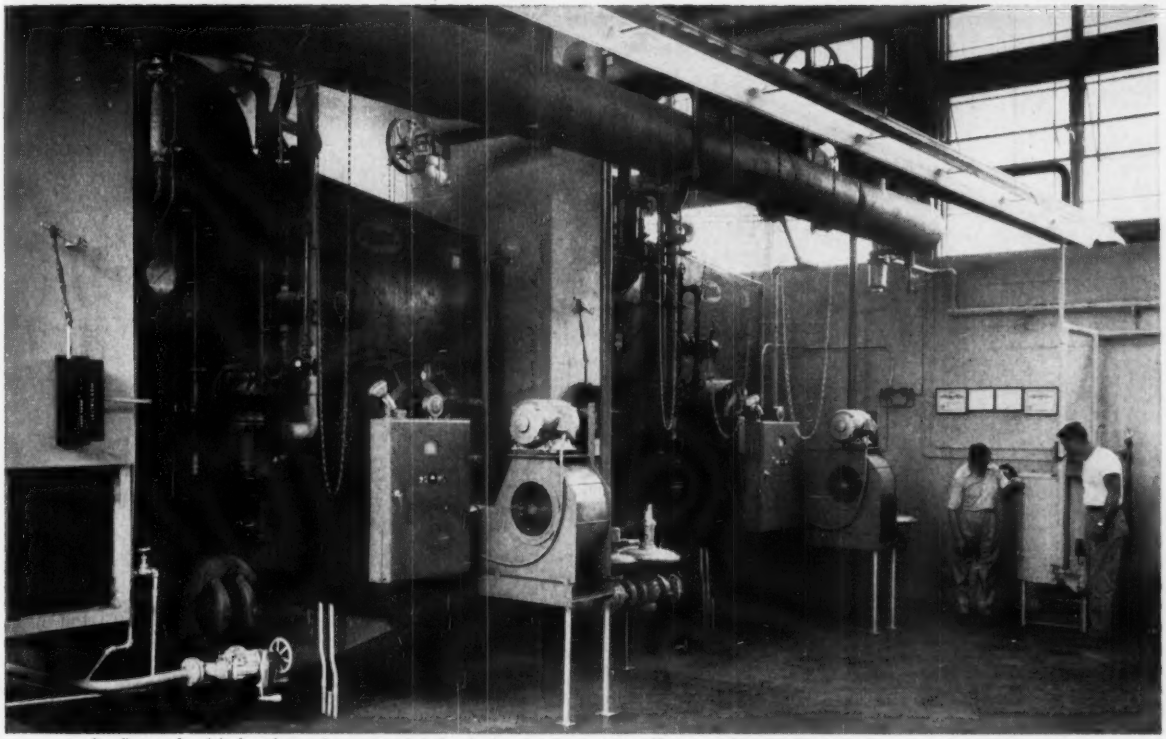
## now completing the first hydraulic turbines for Thailand's Yanhee Project



Shop tests were recently completed on the spiral casing for the first of two 115,000 HP Francis-type turbines being completed by Hitachi for Thailand's Royal Irrigation Department. These will be the first of the planned 8 sets of generating units to be installed at the downstream of the Bhumiphol Dam, as part of the Yanhee Multipurpose Project which will commence operation in 1963 and eventually supply 560,000 kW of power to Bangkok and Thonburi. The vertical shaft Francis turbines have been designed to deliver 115,000 HP under the effective head of 112m and for a speed of 150 rpm. Their spiral casings, with inlet diameter of 4150mm, will each be divided into 7 sections for transportation by barge up the Ping River to the site.

Hitachi, Ltd.
Tokyo · Japan
Cable Address: "HITACHY" TOKYO


For more facts circle 255 on Reader Service card, p 121



*Iron Fireman forced draft gas burners firing water tube boilers that heat three large schools in Washington Township, Toledo, Ohio. Architect-Engineer: McLaughlin and Keil, Lima, Ohio. Mechanical Contractor: Johnson Plumbing & Heating Co., Toledo, Ohio. Iron Fireman Dealer: Stoker Sales & Service Co., Toledo, Ohio.*

# Iron Fireman forced draft firing of water tube boilers gives top performance

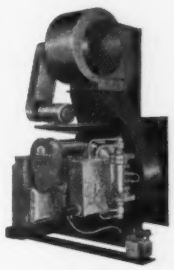
## *with gas, oil or gas-oil combination*

### Complete firing system can be bolted to boiler front — no major alteration

The Iron Fireman units shown above are complete fuel burning systems designed specifically for firing water tube steam generators. Each burner provides forced draft firing for 24,000 lb. steam per hour. This Iron Fireman burner has been selected by many boiler design engineers to fire their modern sealed, high output boilers because it provides its own forced draft, requires no stack or induced draft fan. It includes its own air register, pre-wired control system, and is completely assembled and tested at the factory. Performance and costs are accurately predictable. Backed by the largest group of fuel burning specialists in the United States and Canada.

Iron Fireman equipment cuts your installation costs substantially. In addition, you have a *unit* that has been factory engineered and carefully built for exceptional efficiency and reliability. Backed by a nation-wide service organization.

Mr. O. K. Benton of the Washington Township Board of Education, writes: "For most of last season we ran this equipment 24 hours a day, 7 days a week. Operation has been very satisfactory, with plenty of reserve power for the coldest days."



**A factory engineered package**

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Please send full information and specifications on the burner for firing Water Tube Boilers.

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# ALL-NEW *ElectroniK 17* POTENTIOMETERS

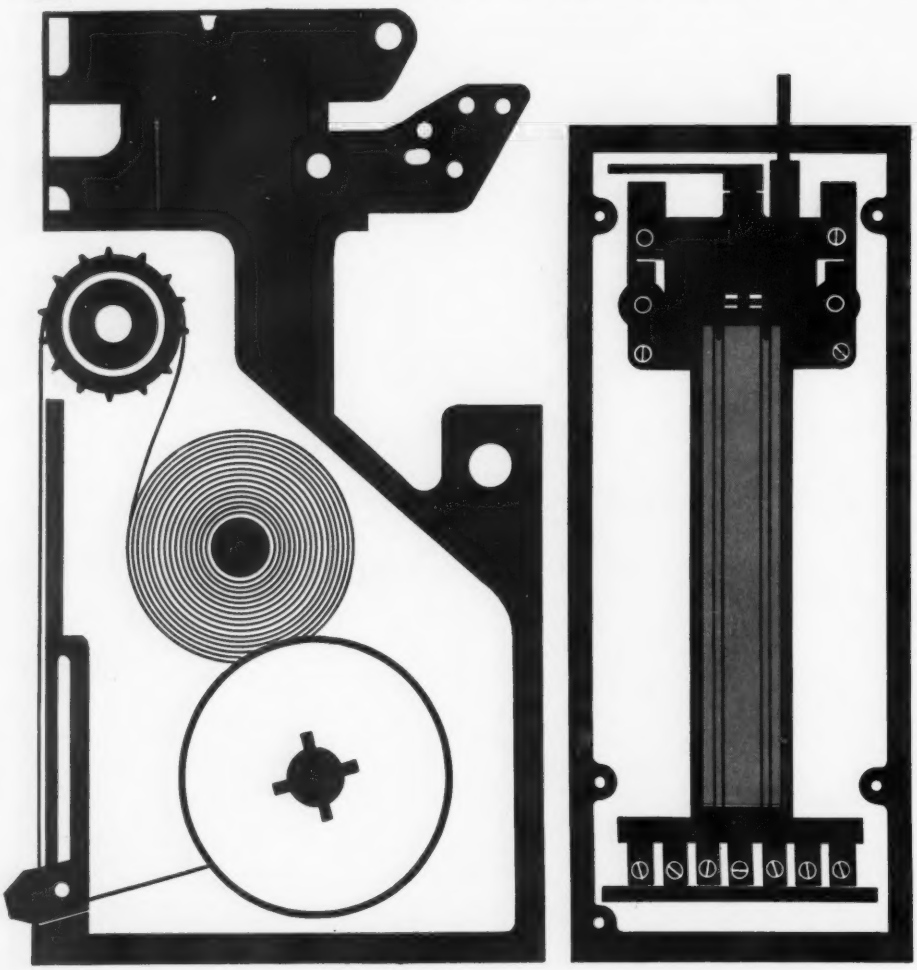
## HAVE NO SLIDEWIRE, NO SLIDEWIRE PROBLEMS

Here is a totally new kind of potentiometer with a totally new kind of measuring system. The *STRANDUCER* replaces the slidewire, and sets a new high standard for potentiometer performance. The new *ElectroniK 17* potentiometers have calibrated accuracy of ±0.25%.

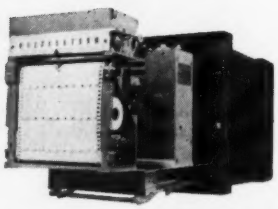
In addition, modular construction makes *ElectroniK 17* instruments easiest of all potentiometers to operate, convert and maintain. Full interchangeability of components cuts service time and spare parts requirements.

You can get *ElectroniK 17* instruments as strip or circular chart recorders or circular scale indicators. You can get electric contact control with up to 8 contacts. All control units are of convenient plug-in type. For all the eye-opening facts about this new class of instruments, call your nearby Honeywell field engineer, or write MINNEAPOLIS-HONEYWELL, Wayne and Windrim Avenues, Phila. 44, Pa.—In Canada, Honeywell Controls, Ltd., Toronto 17, Ont.

The unique *STRANDUCER* rebalancing element works on the proven strain gage principle. Both *STRANDUCER* and pen carriage are linked to the potentiometer balancing motor. A change in electrical input causes the balancing motor to change the tension—and electrical resistance—of the *STRANDUCER*, to reposition the instrument pen or pointer. The *STRANDUCER* is unaffected by corrosive atmospheres and has no contactors. It has unusually long life and infinite resolution and is unaffected when the instrument operates in ambient temperatures up to 130° F.



**True modular construction saves you time, trouble, money.** Three basic modules—case, display and drive—make up the *ElectroniK 17*. The case fits standard 19-inch relay racks. You can remove the door easily and without tools when converting from strip chart to circular chart or circular scale operation. You can pull out the chassis to the service position without tools, and without interrupting operation, or remove it completely. Up to 8 contact control modules can be plugged in for a variety of control possibilities.



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# New free literature

## General equipment and key materials for systems engineering

• **Instrumentation**

**101** **Digital-supervisory control** and telemetering systems are topic of spec sheet available from Moore Associates, Inc

**102** **Recorder** ink-feed systems are subject of 4-p folder 101. Bladder type pen is described. Write Right Company

**103** **Thermocouple** wire and accessories are described in 12-p bulletin 1-500. Applications include diesel engines and steam generators. Claud S Gordon Company

**104** **Tubular gage-glass** assemblies are subject of data sheet 399. Instructions for installation, operation and maintenance are given. Jerguson Gage & Valve Co

**105** **Manual-automatic** control station provides visual check on electronic-system response. Data sheet SRM 463.21 describes the station. It's available from Republic Flow Meters Company

**106** **Altitude,** pressure and density tables give info on environmental sensing and switches for monitoring and control. Newark Controls Co

• **Maintenance**

**107** **Industrial vacuum cleaner** is described in 20-p handbook. Boiler and electric-motor cleaning, salvaging usable waste—a few of the 79 applications mentioned. Breuer Electric Mfg Company

• **Piping, valves, fittings and specialties**

**108** **Plastic-pipe insulation** is discussed in 4-p pamphlet. Temperature limitations, thermal efficiencies, fire ratings and packaging data are given. Gustin-Bacon Mfg Company

**109** **Pneumatic valve transmitter** translates position into proportional output pressure. Revised 2-p circular describes unit. B-I-F Industries, Inc

**110** **Control valves** in cast and stainless steel are suitable for 300-psi and 500-F wsp air, water, oil and gas service. 2-p data sheet JNP-7 is available from OPW-Jordan Corp

**111** **Pinch valves,** manual, electric and hydraulic, are subject of 11-p catalog 609. Construction, specifications and valve system are chapters. Mine and Smelter Supply Co, Mfg Div

**112** **Solenoid valve** selector chart SL-1 gives size, pressure, temperature and assemblies in its 4 pp. J D Gould Company

**113** **Pipe and straight thread adapters** for tubing-system connections are illustrated in 16-p booklet 4360. Parker Fittings & Hose Div, Parker-Hannifin Corp

• **Metals and materials**

**114** **Piezoelectric-device** applications are feature of 16-p brochure. Tables cover its use in converting

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Circle key numbers, page 121, for your copies

mechanical to electrical energy and vice versa. Clevite Electronic Components

**115** **History of glass** is detailed in revised 68-p illustrated bulletin. Chapters discuss role of glass in industry and electronics. Corning Glass Works

- **Prime movers**

**116** **Mechanical-drive turbines** are single-valve multistage units with ratings to 4000 hp. Bulletin GEA-7152 is available from General Electric Company

**117** **Recovery of waste heat** from i-c engines is shown in 24-p article. J B Beaird Company, Inc

**118** **L8V 4-cycle engines** for gas, diesel, dual- or 3-fuel requirements are outlined in 4-p folder 77-2. Describes turbocharger for supercharged engine. Cooper-Bessemer Corp

- **Welding**

**119** **Reference charts** for bronze welding electrodes, bare filler rods and wire are available from Ampco Metal, Inc

**120** **Silver brazing alloys** are topic of 24-p revised manual—also discusses brazing procedures, problems and solutions. Air Reduction Sales Company

## Air-conditioning systems

**121** **Aluminum brick-size vents** for unit air conditioners, boiler rooms and fuel-oil vents are described in 4-p booklet. Construction Specialties, Inc

**122** **Dry type 4-lb air filter** has collapsible, disposable cartridge. 8-p bulletin 228 includes installation, operation and specs. American Air Filter Company, Inc

## Electrical systems

**123** **Digital system** telemeters kwhr readings from remote locations to central load-dispatch office. 4-p brochure GEZ-3312 gives schematics and details. General Electric Company

**124** **EHV products** and test programs are illustrated in 8-p booklet. Controlling corona power losses, eliminating stress-caused conductor and line slapping damage are chapters. Booklet is available from Preformed Line Products Company

- **Generation, transformation and conversion**

**125** **Emergency-generator** selection is topic of 4-p reprint. System, fuel type and transfer control are preinstallation factors. Onan Div, Studebaker-Packard Corp

- **Distribution and protection**

**126** **Interlock switch** cuts current when door of enclosure is opened and re-energizes circuit when door closes. See 4-p pamphlet from Micro Switch Div, Minneapolis-Honeywell Regulator Co

**127** **Tie-line,** frequency, reactive-power and power-limiting control systems are outlined in revised 4-p folder GET-2916B. General Electric Company

continued

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**SEARCHLIGHT SECTION for used and rebuilt equipment, starting on p 233**

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NEW FREE LITERATURE continued ..... circle key numbers, page 121, for your copies

**128** **Load-control** 32-p bulletin is aimed at engineers responsible for protecting machines, tooling and automating equipment. Machinery Electrification, Inc

**129** **Limit switches** for repetitive operation are button, plunger and roller-lever operated. Data sheet GEA-7319 gives info. General Electric Company

**130** **Motion-safety switch** protects against stoppage or reduced-speed damage. 4-p circular MS-3 is available from Fuller Company

**131** **Current-limiting fuses** for short-circuit and overcurrent protection are feature of 8-p bulletin GEA-6319D. General Electric Company

• **Application**

**132** **Sump-pump motors,** 1/3 hp, 1725 rpm, are subject of 6-p bulletin GEA-6687A available from General Electric Company

**133** **Across-the-line** motor starters are illustrated in 36-p brochure 709. Construction, installation and inspection features are detailed. Allen-Bradley Company

**134** **Controls** for synchronous motors rated 600 v and below are topic of data sheet 3100-PRD-269. Electric Machinery Mfg Company

**135** **Electrical-enclosure** specifications and construction are detailed in revised catalog offered by Machinery Electrification, Inc

**136** **Safety precautions** in switch lockout are outlined in guide SG-8 available from the Manufacturing Chemists' Assn, Inc

## Steam and hot-water systems

• **Heaters and burners**

**137** **Indirect-fired** heaters for gas, steam, transfer oil and light and heavy liquids are discussed in 8-p catalog 400. Low metal-wall temperature in heater eliminates refractories. Brown Fintube Company

**138** **Hot-water** storage-tank heaters come in steel, copper-silicon and are cement- and copper-lined types. 16-p catalog 602 includes **piping diagrams and heating** capacity charts. Old Dominion Iron & Steel Corp

**139** **Fired immersion heaters** for asphalt and liquids in tanks are illustrated in 4-p folder 410. Brown Fintube Company

**140** **Packaged incinerator** burners with input capacities to 900,000 Btu per hr are depicted in 4-p circular. Selection and sizing info is included. Combustion Div, Eclipse Fuel Engineering Co

• **Boilers**

**141** **Cyclone collector** is subject of brochure which includes effici-

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B&W Welding Fittings manufacturing is completely integrated with the Division's own engineering, laboratory, steel-making and tube-making facilities. All are put to use to give you a job-matched alloy process piping system . . . welding fittings, flanges *and* pipe, quality-controlled from the melting of the steel to shipment of the finished product.

Integration plus first-hand knowledge of every phase of production enables B&W to furnish you the exact same alloys in fittings and flanges as well as pipe . . . a piping system matched to end-use service. For further information write for B&W bulletin FB78.

The Babcock & Wilcox Company, Tubular Products Division, Fittings Plant, P.O. Box 230, Beaver Falls, Pennsylvania.

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***TUBULAR PRODUCTS DIVISION***

TA-1021 WF 4

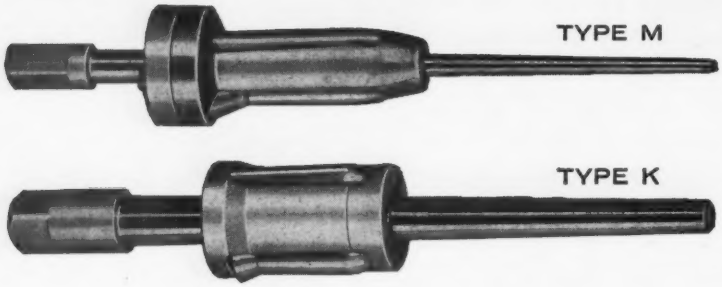
Seamless and welded tubular products, solid extrusions, rolled rings, seamless welding fittings and forged steel flanges — in carbon, alloy and stainless steels and special metals



**For more facts circle 258 on Reader Service card, p 121**

*write for your copy of this Bulletin!*

**ELLIOTT**
*Boiler Tube Expanders*
for tubes 3/4 in. I.D. and up




This 16-page bulletin describes general types of Elliott boiler tube expanders for fast, efficient tube rolling jobs. It also gives dimensions, prices and other descriptive data and shows various drum, header and short series mandrels which are used with Elliott boiler tube expanders. Drum mandrels are seen with Type M and Type K above.

*Accessories available* to adapt Elliott boiler tube expanders to various tube rolling applications include universal joints and extension shafts, sockets, gear drives, etc. A heavy-duty, right-angle gear drive utilizes roller bearings to minimize friction, cutting down power losses.

RIGHT-ANGLE GEAR DRIVE▸
Available in ½, ¾ and 1-in. sizes

Write the Elliott Company, Lagonda Operation, Springfield, Ohio, *today*, for your copy of Bulletin Y-46-A.

Y1-7

**ELLIOTT COMPANY**
*GENERAL OFFICES: JEANNETTE, PENNSYLVANIA*
*PLANTS AT: Jeannette and Ridgway, Pa.: Springfield, Ohio*
TURBINES • GENERATORS • MOTORS • COMPRESSORS • TURBOCHARGERS
DEAERATING HEATERS • EJECTORS • CONDENSERS • STRAINERS • TUBE CLEANERS

## Free literature

Begins on page 121A

ency curves, volume-draft-loss nomographs. Air Pollution Control Div, John Wood Company

**142** **Positive-flow boiler** is illustrated in bulletin 1275. Sizes, ratings and fuel consumption are given. Orr & Sembower, Inc

**143** **Packaged boiler** features built-in heating and circulating pump and integrated electronic control system. Unit, in sizes from 40 to 300 hp, is detailed in 8-p catalog. Boiler Div, Ray Burner Company

**144** **Low-pressure heating** of industrial buildings is discussed in 8-p brochure 649B. Boiler specs and selection data for heating coils and i-d fans are covered. American-Standard Industrial Div

**145** **Residual fuel-oil treatment** alleviates slag and corrosion in boiler systems. Data sheet E1-159 gives details. Nalco Chemical Company

**146** **Side-fired boilers** with horizontal tubes totally submerged to prevent waterline corrosion are subject of 4-p circular A-103. Boiler Div, Eclipse Fuel Engineering Co

• **Controls**

**147** **Electronic combustion controls**—oxygen analyzers, flowmeters, interlock switches and flame-safeguard equipment—are reviewed in 20-p bulletin 1002. Reliance Instrument Div, Electro-Mech Corp

## Fluid-handling systems

• **Compressors**

**148** **Reciprocating compressors,** single and 2 stage, from 7½ to 150 hp, are cataloged in bulletin from Davey Compressor Co

**149** **Packaged compressors** in 825- to 1000-bhp range are 2-cycle turbocharged integral gas-engine-driven units. 6-p brochure 191 gives details. Clark Bros Co

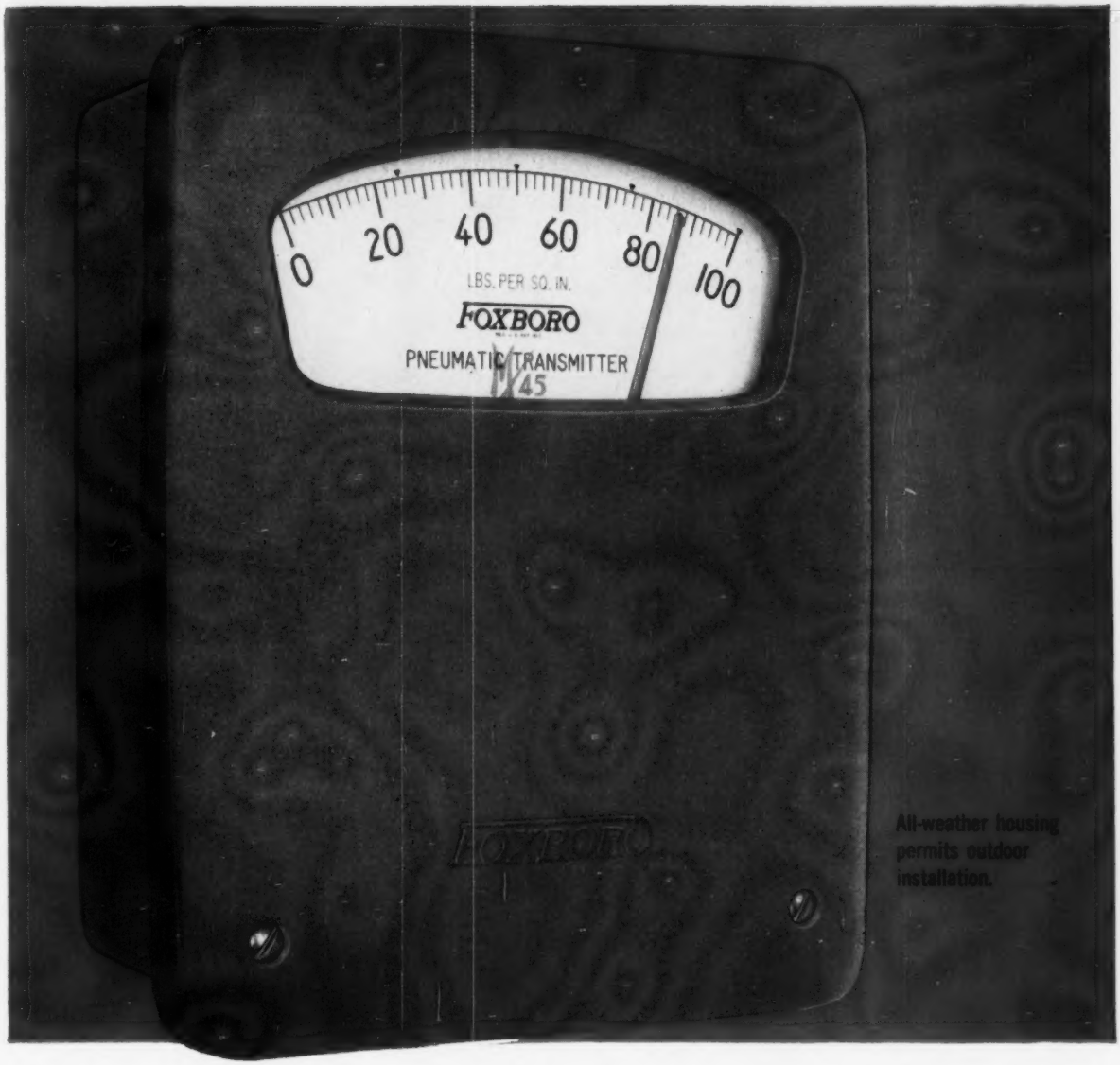
• **Controls**

**150** **Liquid-level alarms** for use with air-actuated purge type gaging systems are feature of spec sheet EX-700. King Engineering Corp

• **Water treatment**

**151** **Automatic analysis** of boiler-water ammonia content down to ppb is topic of 4-p data sheet available from Technicon Controls, Inc

**152** **Determination** of copper content of water is subject of flow dia-




All-weather housing permits outdoor installation.

# You can use this new Foxboro pneumatic transmitter on six different process measurements

## pressure – temperature – liquid level – differential pressure – dew point – flow . . . all six with guaranteed accuracy of ±½ of 1%

Think of it . . . a universal pneumatic transmitter with matched elements for six different process variables. That's the new Foxboro M/45 pneumatic indicating transmitter.

And with the M/45 you get: *universal* high accuracy-guaranteed at ±½ of 1%; *universal* ambient temperature stability — less than ½ of 1% in 50°F temperature change; *universal* calibration and simplicity of servicing. A remarkable combination of versatility and uniformity in a single instrument.

The new Foxboro M/45 indicating transmitter can extend the benefits of standardization throughout your whole plant operation. Ask your Foxboro field engineer to tell you about it. Or write for Bulletin 13-30. The Foxboro Company, 686 Neponset Ave., Foxboro, Mass.

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For more facts circle 260 on Reader Service card, p 121

# MANY FAST'S HAVE BEEN WORKING LONGER THAN YOU

It's a fact. There are plenty of cases where Fast's Couplings have been in service 20 to 40 years. And some of our more enthusiastic engineers say a Fast's should last forever if it's properly applied, installed and lubricated. Whatever opinion you accept, you can bet Fast's Couplings will give you the same smooth-running, low-maintenance, long-lived performance that makes them the choice of more equipment manufacturers than any other gear-type coupling.

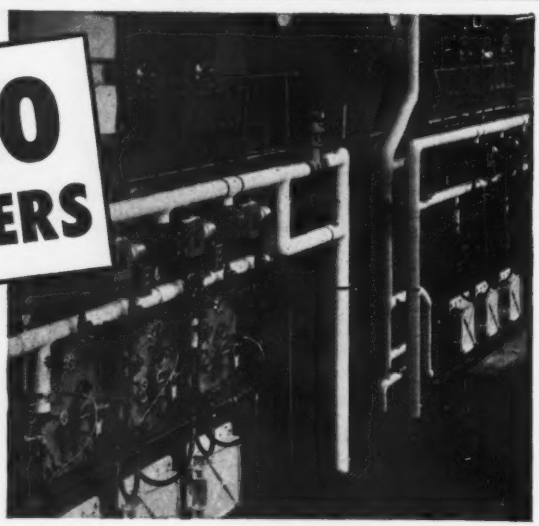
For example, Fast's Coupling No. 1347, shipped in July, 1922, is still in service—and the customer is just ordering his first spare coupling 38 years later. KOPPERS COMPANY, INC., 1106 Scott Street, Baltimore 3, Md.

KOPPERS **FAST'S COUPLINGS**
Engineered Products Sold with Service

For more facts circle 261 on Reader Service card, p 121

# ENCO BURNERS

FOR **OIL, GAS OR TAR**



**Steam or mechanical atomizing...1 to 1000 gallons per hour**

Designed for operation with either gas, oil or both with natural or forced draft. They can be depended on for maximum combustion efficiency.

ENCO Interchangeable Oil-Burners can be changed instantly to operate by either steam or mechanical pressure atomizing over a wide capacity range.

ENCO Oil Atomizers are applied to various types of standard pulverized-coal and gas-burner units cold starting or for full load operation when coal or gas is not available, or when oil is the more economical fuel.

Send for Bulletin OB-53 describing ENCO Gas and Oil Burners, also complete Pumping and Heating Units.

EC 509

**THE ENGINEER COMPANY, 75 West Street, New York 6, N. Y.**

For more facts circle 262 on Reader Service card, p 121


## Free literature

Begins on page 121A

gram. See 2-p circular from Technicon Controls, Inc

### Mechanical transmission systems

**153** **Wall chart** simplifies selection of pitch sizes for power-transmission chain. Foote Bros Gear & Machine Corp

**154** **Variable-speed** 8-p belt guide includes measurement, installation and price computation. Manheim Mfg & Belting Co

**155** **Pulleys,** speed-pulley drives and belts, sheaves, motor and countershaft bases are depicted in 34-p catalog 61B. Lovejoy Flexible Coupling Company

**156** **Flexible couplings,** belts and universal joints for applications to 1750 rpm are topic of bulletins 61A, 61C and 61D. Lovejoy Flexible Coupling Company

### Energy-systems services

**157** **Sound lab** is equipped with instruments for electrical, electro-acoustical and vibration measurement. Facility, available to industry for testing, is portrayed in 4-p folder 51B9775 from Allis-Chalmers Mfg Co

**158** **Design,** engineering and manufacturing facilities and products available for industrials and utilities are pictured in 16-p booklet. Kurz and Root Company

**159** **List** of POWER's special reports with descriptions of each is available. Basic power facts, water treatment, bearings and lubrication and air conditioning are sample topics. POWER

EDITOR'S NOTE: *The following bulletins may be requested directly from the manufacturer. Write on company letterhead to addresses listed below:*

★ **Mechanical - power - transmission equipment** manual features drawings, dimensions, weights and prices in its 468 pp. Selection and application info are sections. Dodge Mfg Corp, Mishawaka, Ind.

★ **Crossbars** are subject of 20-p brochure. Actuation, control and test results are reviewed. Chapters cover signal-carrying and signal - switching performance. James Cunningham, Son & Company, Inc, 23 Litchfield St, Rochester, N. Y.

★ **Electric-eye** applications in automation are feature of 22-p reference manual 611. Photoelectric systems are illustrated. Photomation, Inc, 96 S Washington Ave, Bergenfield, N. J.

continued

YARWAY news briefs

*from* **Yarnall-Waring Company,** *Philadelphia 18, Pa.*

*BRANCH OFFICES IN 19 UNITED STATES CITIES • SALES REPRESENTATIVES THROUGHOUT THE WORLD*
*STEAM TRAPS STOCKED AND SOLD BY 270 LOCAL INDUSTRIAL DISTRIBUTORS*

# SOLID SUCCESS!

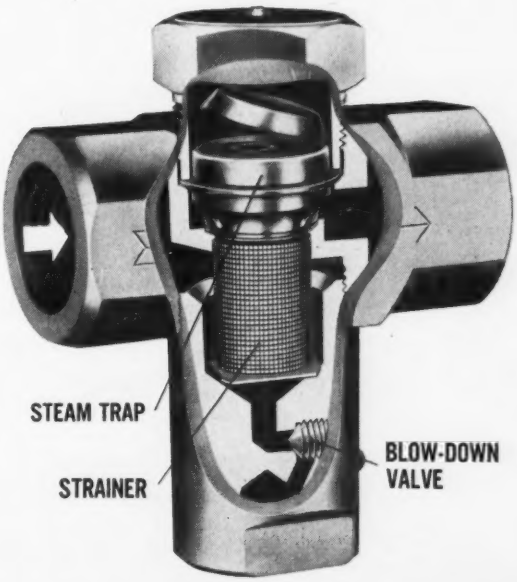
## Yarway Series 130 Combination Steam Trap Wins Wide Approval

In chemical plants, refineries, other process plants, utilities, institutions—wherever condensate is handled in moderate amounts—this new Yarway Impulse Steam Trap is winning friends by the score.

Because it is a unique combination steam trap, strainer and blow-down valve, it offers these advantages no other steam trap can duplicate:

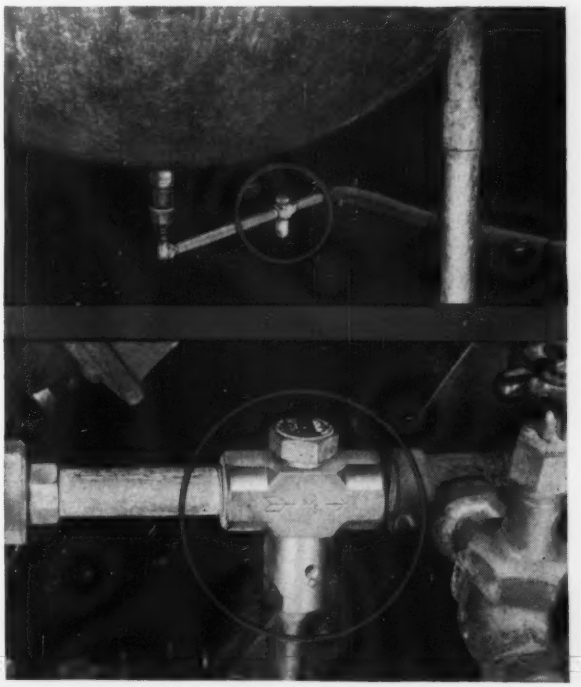
- IT SAVES SPACE—entire trapping hook-up requires no more space than a "T" fitting.
- IT SAVES MONEY—only one unit to buy and install, *up to 30% savings in time and materials.*
- IT SAVES WORK—easy to install, easy to maintain. Stainless steel construction. Good for all pressures 8 to 600 psi. Sizes ⅜" and ½".

Why don't *you* try a Yarway Series 130? Your nearby Yarway distributor can supply you—or write for Yarway Bulletin T-1743B.




### CHEMICAL PLANT REDUCES CORROSION FAILURE —LIKES "COMPACT" DESIGN

For years, traps and strainers of iron and steel were subject to HCl and $H_2SO_4$ acid corrosion failure in this chemical plant. Installations lasted only a few months. Now Yarway Series 130 steam traps are solving this corrosion problem because the trap, strainer and blow-down valve are combined in *one stainless steel body.* In addition, trapping hook-ups on processing kettles are greatly simplified.

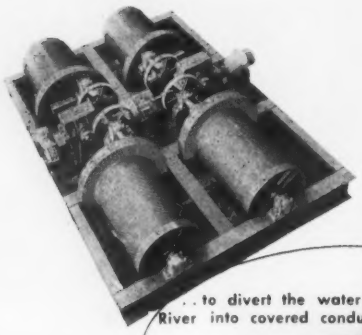


### LAUNDRY OVERCOMES SPACE PROBLEM...GETS FASTER HEAT-UP, NO WATER HAMMER

Space was at a premium for steam trapping around the presses in this laundry, and also they couldn't get fast heat-up without water hammer. Yarway Series 130 combination steam traps solved all three problems to their complete satisfaction.



For more facts circle 263 on Reader Service card, p 121



One of the two 380-ton MURCO Gate Hoists furnished to the Power Authority of the State of New York.

Each hoist operates a gate 46' wide by 67' high at one foot per minute. These gates divert the water from the Niagara River above the Falls into covered conduits five miles long. The two conduits bring the water to the Niagara Generating Plant on the United States side of the Falls.

. . to divert the water from the Niagara River into covered conduits . . .

**MURCO Gate Hoists**

. . to Control Water Level at Long Sault Dam, St. Lawrence Power Project . .

For the second largest hydroelectric power plant in the United States at Massena, New York — as part of the St. Lawrence power project — Uhl, Hall & Rich, project engineers, selected MURCO Gate Hoists. Each hoist weighs 93,000 lbs. . . . overall length 57 feet, 8½ feet wide, 12½ feet high . . . lifting capacity of 175 tons and will raise and lower the gates in a dam at a speed of 1 foot per minute.

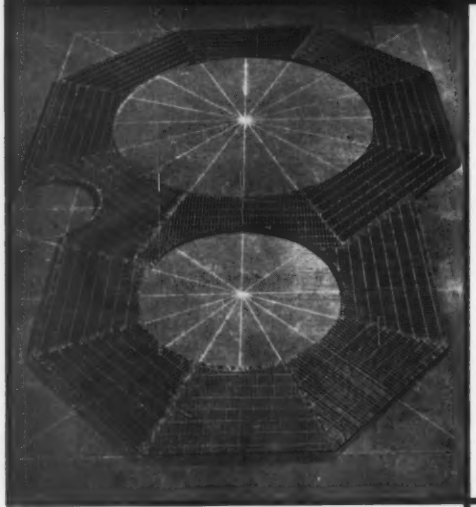
*Write* for complete information . . . Engineering Department recommendations . . . when you are planning power dam projects.

**D. J. MURRAY MANUFACTURING CO.**

MANUFACTURERS SINCE 1883 WAUSAU • WISCONSIN

For more facts circle 264 on Reader Service card, p 121

**PERFECT FITTING . . . . Grating Panels**



*Insure Job-Site Accuracy*

•

*No Costly Corrections*

Unretouched photograph shows shop assembly of grating panels. Note exact fit of panels to drawing! Specify Kerrigan's electronically weldforged steel grating . . . . . and get carefully inspected, match-marked panels for easy field assembly.

*Write now for new, easy-to-use catalog!*

**KERRIGAN**
IRON WORKS COMPANY
Nashville, Tennessee

ADDRESS: DEP'T. P-6

For more facts circle 265 on Reader Service card, p 121


## Free literature

*Begins on page 121A*

★ **De power supplies** and test instruments are subject of 16-p bulletin. Specifications are furnished with dimensions, weights and ratings. The Opad Electric Company, 43 Walker St, New York 13, N. Y.

★ **Air and hydraulic cylinders** are covered in three bulletins. Bulletin 204 features h-p hydraulic cylinder, 2000 to 3000 psi, bulletin 203 medium pressure, 500 to 2000 psi. Bulletin 202 covers air cylinders to 200 psi. Cylinder construction and specs are given for each. Mo-Bar Hydraulics Co, Crystal Lake, Ill.

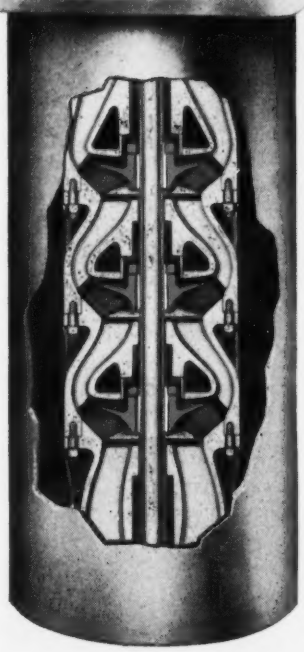
## "Biological" computers help study electronic ones

Visitors to the University of Illinois Biological Computer Lab will not find a box labeled *biological computer*. But the lab has them—living creatures which respond in an orderly manner to the stimuli of an ordered environment. These creatures must apply some computational principles in order to survive; a roach escapes when you try to step on it because it has figured out your pattern of movement in time to get away.

Electronic computers perform relatively simple operations with fast and ultra-reliable electronic components. Living systems have to respond quickly and reliably to stimuli although their information-handling component—the nerve cell—is slow and unreliable. But the living creature has a versatile information-*processing* network. Computer Lab people are interested in analyzing the structure of these networks in order to build electronic devices with an animal's adaptiveness and self organization.

The organism, through its sense organs and nervous system, selects ordered events from its chaotic surroundings. Artificial biological computers can be made to adapt themselves to their environments by sensor units and computational networks sensitive only to certain intensities of light, frequencies of sound and pressures. These devices are known as "property filters". One such filter constructed at the University is an array of photocells which "sees" the number of disconnected objects in the visual field of its retina when connected to an appropriate network.

# new COST-SLASHING SERVANTS for industry!



## F-M TURBINE POT PUMPS

Now . . . get true pumping *economy* and *versatility!* F-M Turbine Pot Pumps do the trick—*and take less plant space than other types of pumps!*

Our unique "pot" principle prevents need for space-taking pits . . . helps attain higher pressures.

Compact F-M Turbine Pot Pumps are ruggedly built for longer life—continuous, trouble-free operation. Each pump provides higher output (capacities from 10 to 30,000 gpm), with pressures up to 3000 psi.

F-M Turbine Pot Pumps are *flexible* for *extra* savings! Their unique, close-coupled turbine design makes them adaptable to changing operating conditions with minimum expense.

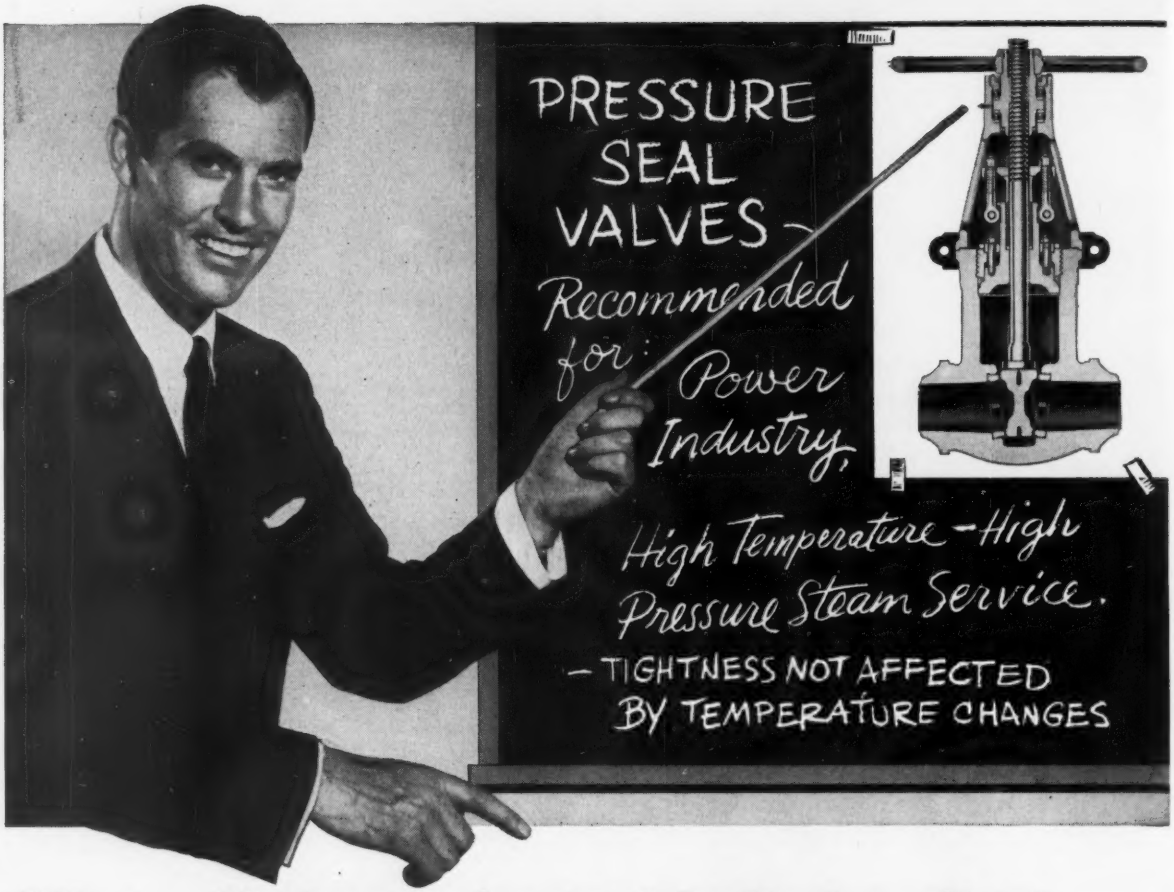
F-M Turbine Pot Pumps are the answer to many liquid-moving needs—from clear water to hot or cold, corrosive or non-corrosive, volatile, or non-volatile liquids. They are available with mechanical seals for any pressure range.

Fairbanks-Morse has a quality-engineered Turbine Pot Pump for almost every range of industrial service . . . water supply, air conditioning, water flood, process-pumping. And—Fairbanks-Morse service will help you enjoy continuous pumping operations . . . all the time . . . anytime!

**For further information write: Pump & Hydraulic Div.; Fairbanks, Morse & Co.; Kansas City, Kansas.**

**FAIRBANKS MORSE**
A MAJOR INDUSTRIAL COMPONENT OF
**FAIRBANKS WHITNEY**


For more facts circle 266 on Reader Service card, p 121




# "See...No heavy bonnet bolts to adjust on R-P&C Pressure Seal Valves"

"The R-P&C Pressure Seal Valve pictured here is an outstanding example of a modern valve designed for modern service. Built to give **absolute tightness** under high temperature, high pressure conditions, it has **no heavy bonnet bolts** to adjust. Instead, bonnet bolts and flanges are replaced by a pressure seal bonnet joint which completely eliminates leakage even when pressure and temperature are reduced during a line shutdown. Moreover, the bonnet joint on this valve may be removed and reassembled with greater ease than a conventional bolted bonnet."

Notice, too, that this valve has a **compensating type wedge** which adjusts for tight closure and overcomes sticking or jamming when wedge is seated.

Castings for all pressure seal valves are produced in R-P&C's own steel foundry and are subject to critical internal examination by our own Radiographic X-ray equipment.

R-P&C Pressure Seal Valves are available through 14" size in Gate Valves and through 8" size in Globe and Lift Check Valves. All are available in the 900-1500 and 2500 pound classes.

For complete details about pressure seal valves or any valve in the R-P&C line, **consult your R-P&C distributor.**

# R-P&C VALVES

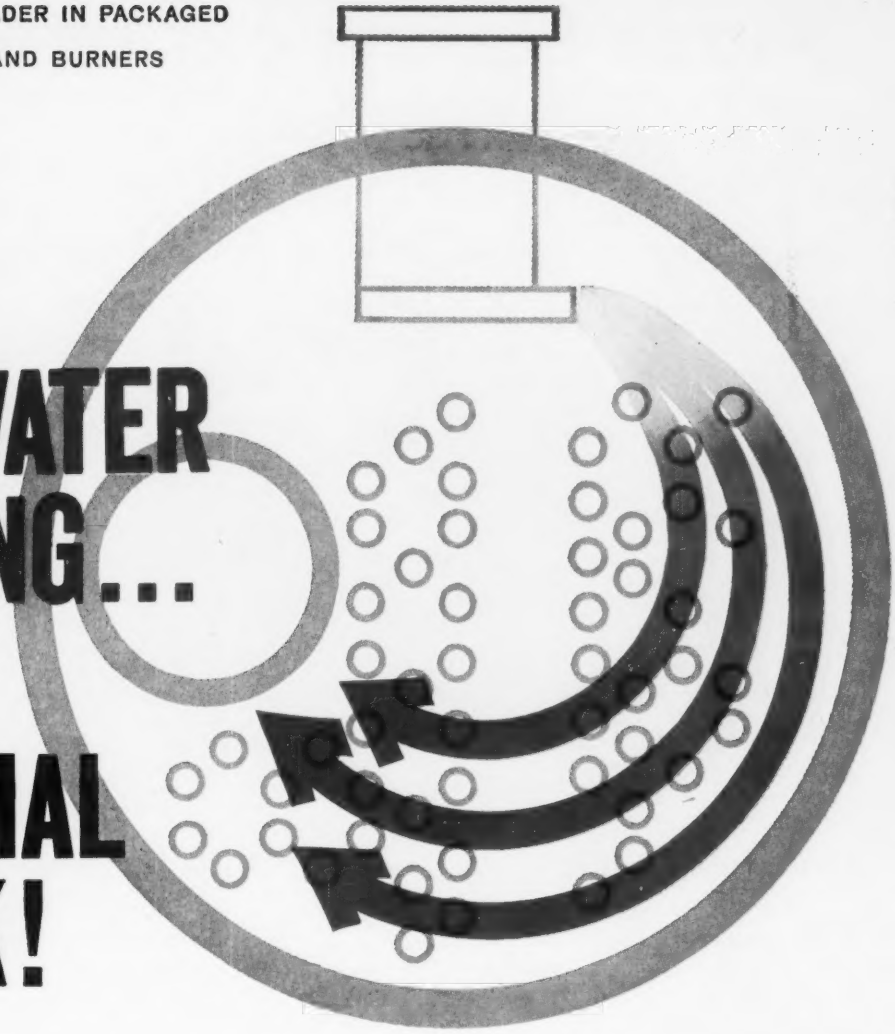
ACCO

**R-P&C Valve Division, American Chain & Cable Company, Inc.**

Reading, Pa., Atlanta, Boston, Chicago, Denver, Detroit, Houston, Los Angeles, New York, Philadelphia, Pittsburgh, San Francisco, Bridgeport, Conn.

FROM THE WORLD LEADER IN PACKAGED
AUTOMATIC BOILERS AND BURNERS

# FAST HOT WATER HEATING... NO THERMAL SHOCK!

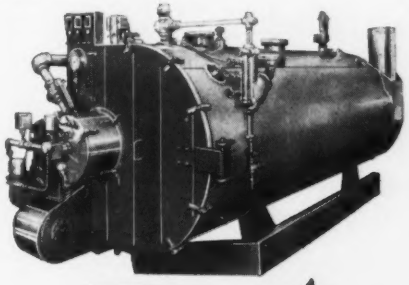


Orr & Sembower's new *Powermaster Positive Flow*® hot water boiler is lauded as the world's most "engineering endorsed" packaged boiler. No other boiler can match it for performance, dependability and economical generation of hot water!

Design permits return water injection and natural thermal circulation to augment each other, resulting in the most efficient form of heat transfer—*counterflow*. The effect of thermal shock—a result of a rapid change in temperature differentials—is eliminated. Top inlet, with specially designed internal distributor of stainless steel, assures full-flow heating.

Another money-saving extra is *Powermaster's* exclusive 5 to 1 turndown that eliminates waste of fuel in low or high firing ranges. You get the same high efficiency in *every* operating range.

Get the most for your boiler investment—proven *Powermaster* boilers. Call your nearest O&S representative or write for Bulletin 1275.



BUILDERS OF BETTER BOILERS SINCE 1885

**ORR & SEMBOWER, INC.**

850 Morgantown Road

Reading, Pa. • Since 1885

*Powermaster*®

PACKAGED AUTOMATIC BOILERS

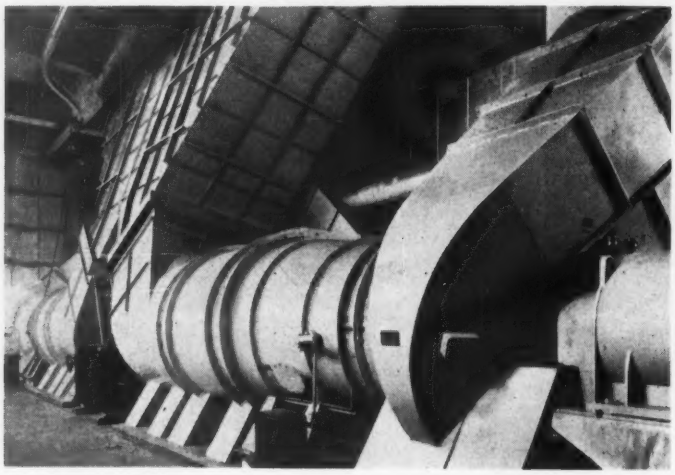


For more facts circle 268 on Reader Service card, p 121

# Plant equipment news . . . Your

For more data on these developments, circle key numbers on Reader Service card, p 121

## Variable axial fan regulates continuously at constant speed



1 • Variable axial-flow fan for induced or forced draft or cooling has high efficiency within regulation range, continuous regulation from zero to maximum output at constant speed and minimum power consumption. Fan reaches higher than average rotational speeds with complete safety. Set of blades can be replaced in three to five hr through housing door, without rebalancing fan wheel.

Standard sizes handle capacities from 50,000 to 1,100,000 cu ft per min; larger sizes produce pressures to 25-in. wg and NTP conditions. Fans operate to temperatures of 400 F. Special alloy models are available for 650-F operation.—Novenco Inc

## Voltage-sensitive control

2 • Current-bias capacitor control has balance-beam regulating relay. Current pickup modifies straight on-off control. Capacitors are off during light loads and on during peaks.

When preset current value is reached, shorting relay contact inserts a resistance in the regulating relay circuit. Voltage is decreased, which energizes the timer. Function is relayed, switching capacitors onto circuit.—Allis-Chalmers Mfg Co

## Dial bandwidth settings

3 • Bandwidths of $\pm\frac{3}{4}$ v are desirable because they produce added feeder revenue through increased line length or capacity. Now, voltage levels and bandwidth settings on manufacturer's single- and 3-phase step regulators can be dialed to desired levels, and regulators can be adjusted in ten seconds. The calibrations are easily seen and settings remain locked in position.—General Electric Company

## Explosionproof elbows

4 • Pulling elbows for hazardous wiring areas are explosionproof and dust-tight.

Rollers at ends of chamfered wiring chamber reduce friction when conductor is drawn through hub, eliminating insulation damage. Angled opening provides accessibility during pulling. Reversible dome cover bolts in either direction. Elbows in $2\frac{1}{2}$- to 4-in. sizes are of malleable iron.—Appleton Electric Company

## Rotary displacement meter

5 • Rotary positive-displacement meters measure gas at pressures to 125 psi. Connections are flanged for mounting in 3-in. pipe, and no special supports are needed for vertical or horizontal mounting. Volume counter is located in case for protection. Oil replenishment is only maintenance required—bull's-eye oil-level gage tells how much. Meter can be provided for standard instrumentation.—Roots-Connersville Blower Div, Dresser Industries

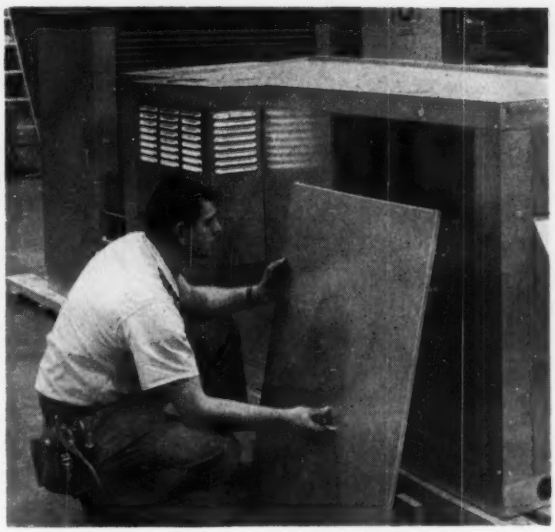
## 200-point alarm scanner

6 • Transistorized alarm scanner checks up to 200 measured variables at the rate of one point per sec. Instrument activates a recorder and alarm lamp and energizes any external alarm system. Upon completion, it returns to normal scanning and alarm lamp is left on until reset button is depressed. Alarm-condition measurement and location are recorded. Recorder is energized only if an alarm condition is discovered, assuring longer life.—Bristol Company

## Pocket-size tester

7 • Calibration tester simulates dc electrical output of transducers with 0.05% setting accuracy. It is matched to transducer curve in direct or indirect reference terms. A 8-oz direct-reading source tests recording or indicating instruments in millivolt or microvolt range, maker states.

The 12-ft scale can be graduated in several ranges in terms of instruments' cardinal points or with 1000 scale divisions in single range.—Howell Instruments, Inc



## Roof-top unit separates cooling and heating

**8** • A 7½-hp roof-top unit has a total 75,900-Btu-per-hr cooling capacity; output of gas furnaces is 160,000 Btu. Heating and cooling sections are separate—two fans on common shaft, 1-hp fan motor and variable-pitch drive, filters and two 100,000-Btu-per-hr input-duct furnaces comprise heating section. Cooling section contains air-cooling condensing unit, evaporator coil and control box. It is precharged with refrigerant. Sections are prewired, mounted on 4-in.-channel iron frames and enclosed in aluminum panels. Removal of one panel gives access to fan, fan motor and drive, filters and burners. Heaviest single piece of unit weighs 1200 lb, simplifying the rigging and hoisting problem.

Supply and return air enter through single ceiling diffuser for easy connection. Alternate external supply and return duct connections can be made. Special channel joints prevent leakage.—Westinghouse Electric Corp

## Dry type air filter

**9** • Dry type filter has air-cleaning efficiencies to 97%. Filter inflates when ventilation system is in operation and collapses when system is shut down. It can be serviced from air-entering or air-leaving side of filter bank. No backup wire grid is necessary, reducing filter damage.

Disposable filter has folding 8-lb cartridges. Rated at 2000 cfm, it provides 95-sq-ft media surface.—American Air Filter Company, Inc

## Filter dust collector

**10** • Dust collector, for service to 550 F, provides air-cloth ratios from 5 to 10 cu ft per sq ft. Reverse air cycle collapses bag. Nozzle in cap at top releases pulses of air which induce a current from the top on down. This flexes and opens collapsed tube and purges dust into hopper, getting rid of trapped dust without damaging fabric. 20-sec cleaning cycle, operated by a pressure control, produces little fluctuation in volume.—Dustex Corp

## Weatherized cooling units

**11** • Straight cooling units and heat pumps in 8- to 10-ton range combine cooling with noise reduction. Sound energy in compressor shell is taken up in cooling the motor. Units start against any load, permitting the use of automatic-resetting high-pressure controls. Fan is only moving part exposed in updraft design—compressor, blower motor and controls are in separate compartment.—General Electric Company

## Rotameters for superpressure flows

**12** • Transmitting rotameters for flows to 50,000 psi make direct measurement possible. Four sizes have capacities from 0.90 to 47.0 gpm. Higher capacities can be achieved by installing meter in a bypass with the orifice plate in main pipeline.

Meters feature integral pulsation damping; they operate on a dashpot principle. Damping device smooths out cyclic or intermittent flow surges to maintain straight-line readout. Pressure ratings decide materials. Stainless-steel or K-monel bodies are forged in one piece and have no welded connections.—Brooks Instrument Company, Inc

## Electronic vertical balancers

**13** • Electronic single-plane unit balances rotating parts up to 200 lb and 30 in. in diameter. It is simpler and faster to operate than cradle devices, maker claims.

Four potentiometers permit four separate calibrations of the meter. After reference-mark location and amplitude of unbalance are noted, electrical braking stops rotating piece quickly. Piece is returned to position shown by strobe light and heavy or light spot shows up. Switch determines whether weight is to be removed or added, depending on lightness or darkness of spot. Price: $2750. —Industrial Balancer Dept, Stewart-Warner Corp

For more data on these developments, circle key numbers on Reader Service card, p 121

**FOR ACCURATE MEASUREMENT OF STEAM CONDUCTIVITY**

MOST modern and efficient system of removing volatile amines, ammonia and carbon dioxide prior to recording steam conductivity. This thoroughly effective steam degasser uses a cation exchange resin for the removal of ammonia, morpholine, cyclohexylamine, and reboiling for the removal of $CO_2$. Constant sample temperature is maintained. Taps provided for drawing sample for other analyses.

Larson-Lane Steam and Condensate Analyzers make possible rapid and accurate measurement of steam purity, completely essential for efficient boiler operation.

A smaller, less expensive unit, the CH-16 provides for removal of ammonia and amines from steam condensate without the necessity of reheating. Condenser leakage is readily detected with this model in the presence of volatile amines or ammonia.

*Write today for complete technical details.*

*Industrial Instruments* Inc.
89 Commerce Road, Cedar Grove, Essex County, N. J.

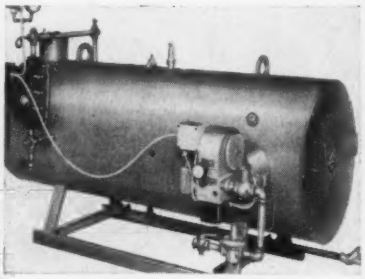
circle 269 on Reader Service card, p 121


## Equipment news

Begins on page 132

### Corrosion protection for chimneys

65 • Greater use of low-cost coal, heavy fuel oil and refinery sludge in boiler operations has triggered development of a corrosion-resistant product for brick, steel and concrete chimneys. It was field-tested by 24 utilities, operating with positive and negative pressures. Product protects against acids formed by sulfur dioxide, sulfur trioxide, hydrogen chloride and hydrogen fluoride.—Benjamin Foster Company



### Economy boiler fired at side to save space

34 • Side-fired design is said to save 20% floor space. New boilers come in gas-, oil- or combination-fired models. They operate from 201,000- to 1,500,000 Btu-per-hr output at a standard 100- or 125-lb working pressure. Horizontal design puts all tubes below waterline to cut corrosion.—Eclipse Fuel Engineering Co

Just circle key numbers on the Reader Service card, page 121, to get complete product story

### Aluminum welding wire now rated 'nuclear grade'

37 • Super-pure aluminum welding and brazing alloys are certified "nuclear grade". They're available in precision-spooled wire and cut rods. These alloys contain very little lithium, cadmium, boron and cobalt. Major applications may be reactor, tank and pipeline fabrication.—All State Welding Alloys Company, Inc

continued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circle 270 on Reader Service card, p 121

ANOTHER ACHIEVEMENT IN MODERN FLOW CONTROL BY CRANE

## CRANE PRESSURE-SEAL BONNET GATE VALVES

are built to meet the toughest demands of high pressure/temperature steam and power piping systems. Special metals—silver, stainless steel, chrome and Stellite* guard all critical valve areas:

1 chrome-plated retaining ring remains freeze-free for easy dismantling; 2 precision tapered silver-plated seal ring eliminates bonnet joint leakage; 3 stainless steel inlay in body insures tight sealing, maximum protection against corrosion; 4 Stellite-faced seating surface and seat rings are engineered for trouble-free, minimum-maintenance service.

Crane Pressure-Seal Bonnet Gate Valves are armored with special metals and careful engineering details. Full travel disc guiding prevents wear and drag on seating surfaces. Flexible wedge disc won't stick even when the valve is closed hot and opened cold. Valve yoke is mounted to the body, transmitting operating torque directly to the valve. The smooth flowing contour design allows straight-through flow with no turbulence.

These gates are your best bet for long, safe, dependable service.

**Sizes 1" to 24"; 600-, 900-, 1500- and 2500-pound classes**

*Stellite is a registered trademark of Union Carbide Corp.

All Crane Pressure-Seal Bonnet Valves are ASA-rated. Minimum metal thicknesses comply fully with the requirements of ASA B16.5–1957, the ASA Code for Pressure Piping and the ASME Boiler and Pressure Vessel Code.

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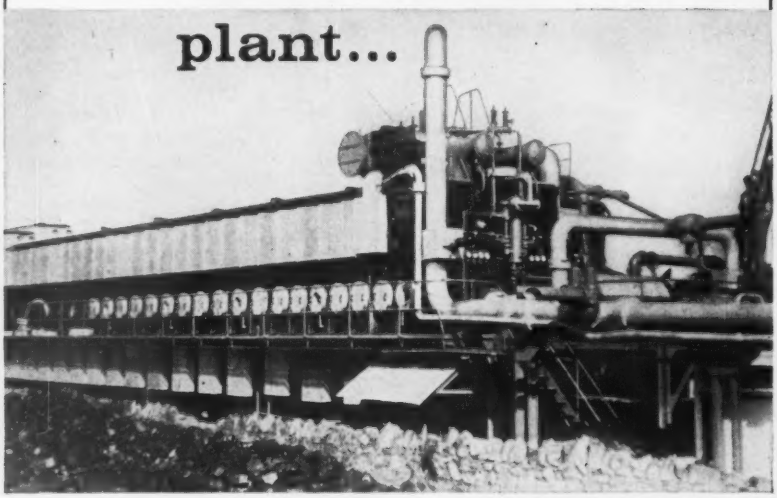
For more facts circle 271 on Reader Service card, p 121

# the world's most efficient seawater distillation plant...



***...so economical to operate it pays out even where rainfall is plentiful***

The 600,000 gallon per day Weirwater Plant on the Island of Guernsey in the English Channel provides "rain insurance" to a thriving agricultural industry. Significant is the fact that this is the first seawater distillation plant in an area of more than adequate rainfall and yet a Weirwater Plant proved to be the most economical solution. High local fuel cost dictated a maximum economy design and Guernsey's Plant produces more than 22 gallons of Weirwater for every pound of fuel, making it the world's most efficient seawater distillation plant.

**Weir Chicago Bridge** INC

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*Combining the experience of*
*G. & J. Weir Limited of Scotland and the Chicago Bridge & Iron Company, U.S.A.*

**weirwater**

WC-611

DISTILLED FROM THE SEA

**For more facts circle 272 on Reader Service card, p 121**

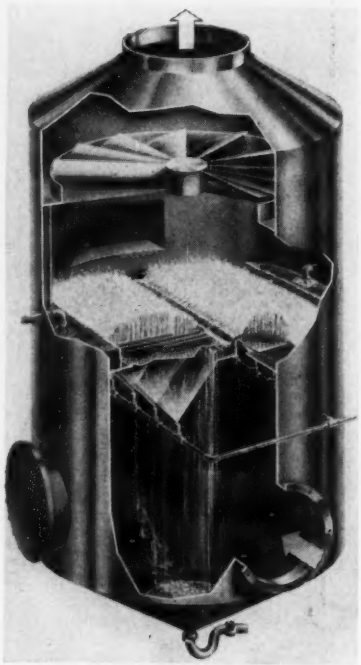

## Equipment news

*Begins on page 132*

### Digitizer is easily installed on recorder

**50** • Kit adapts digitizer to ¼-sec Minneapolis-Honeywell Brown recorders. Data is recorded in digital form, accompanying recorder's strip-chart record. Installation uses existing mounting on recorder, requires no drilling or tapping. Digitizers provide 1000 counts for full-scale deflection of recorder pen, low driving torque and inertia values. When installed, they cause no degradation in recorder performance specs, maker states.—Coleman Electronics, Inc

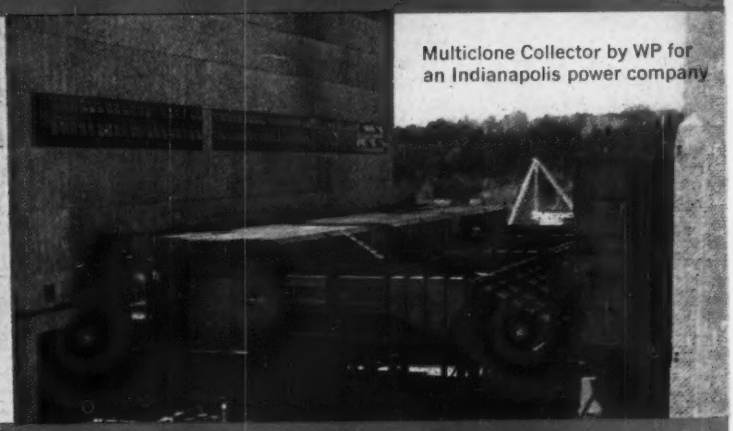
Just circle key numbers on the Reader Service card, page 121, to get complete producr story



### Scrubber is available with multiple impingement plates

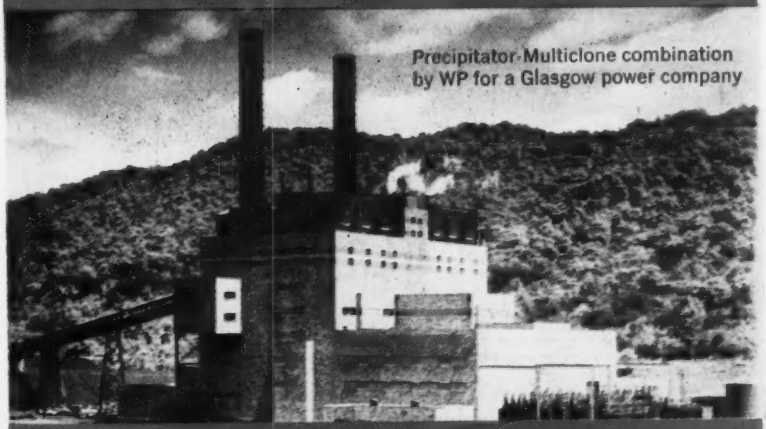
**54** • Impingement-plate scrubbers wet-clean, absorb or cool gases. Turbulent interaction of gas and liquid does the scrubbing. Single-stage scrubber handles dust loadings at inlet up to 100 grains per cu ft, can remove suspended materials ranging from submicron fumes to dust particles in larger micron sizes. Major parts are shell, gas inlet, one or more

**circle 273 on Reader Service card, p 121**



Multiclone Collector by WP for an Indianapolis power company

## Power plants in Indiana... and West Virginia...agree:



Precipitator-Multiclone combination by WP for a Glasgow power company

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For an efficient, economical solution to any dust control problem—look to Western Precipitation. WP is uniquely fitted to handle your unique problem -- being the one organization that custom designs, engineers and installs ALL types of dust and fume control equipment: Precipitator, Mechanical, Jet-Cleaned Filter, Hi-Temp Filter, Scrubbers and engineered combinations.

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**Dust and fume control since 1907**

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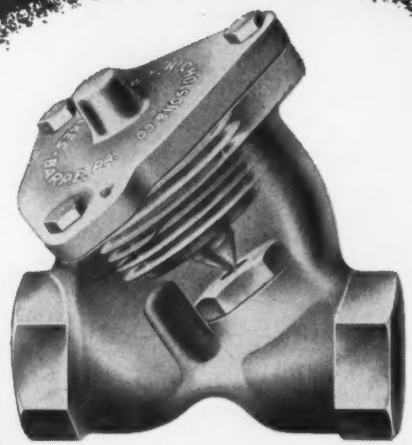
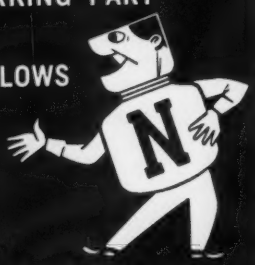
A NEW DEVELOPMENT
FOR STEAM-SAVING EFFICIENCY

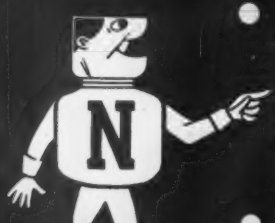


Nicholson Thermostatic Steam Trap Model N-150

- ALL STEEL CONSTRUCTION
- JUST ONE WORKING PART
- RUGGED MONEL BELLOWS
- NEW BAFFLE* . . . deflects steam upward and away from the orifice to surround the bellows



- FREEZE PROOF WHEN INSTALLED VERTICALLY
- CAN BE TESTED AND INSPECTED WITHOUT BREAKING PIPE CONNECTIONS
- COMPACT, LIGHTWEIGHT, EASY TO INSTALL



- FOR TRACER LINES also Plating Tanks Platen Presses • Unit Heaters • Sterilizers and various types of Cooking and Laundry Equipment. N-150 Traps can also be used as air vents for Receivers, Water Heaters, Mechanical Traps, etc.

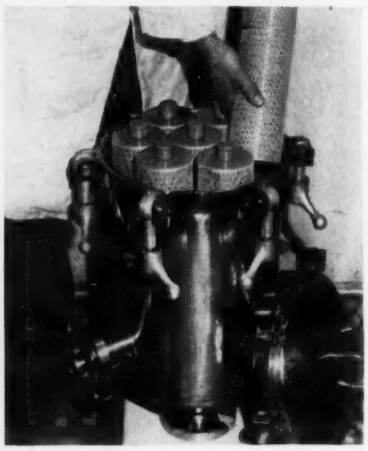
- W. H. NICHOLSON AND CO.
12 Oregon St., Wilkes-Barre, Pa.

* Patent applied for

## Equipment news

Begins on page 132

impingement-plate stages, mist eliminator and clean gas outlet. There are no moving parts and units can be furnished with round shells or rectangular casings to fit particular space.—The W W Sly Mfg Co



### Filter cleans oil to three microns at 170 gpm

**25** • Hydraulic and other petroleum-based fluids as well as water can be filtered to 3-micron cleanliness at rates up to 170-gpm continuous. Unit has high dirt capacity; maker states that no recirculation or preliminary filtration is needed.

Heart of the filter assembly: fiberglass-membrane primary throwaway cartridge. Fiberglass combines fine filtration with large dirt capacity, membrane takes out large particles and stops migration. A third-stage woven-wire-mesh filter provides 98% 5-micron, absolute 18-micron filtration.—Aircraft Porous Media, Inc

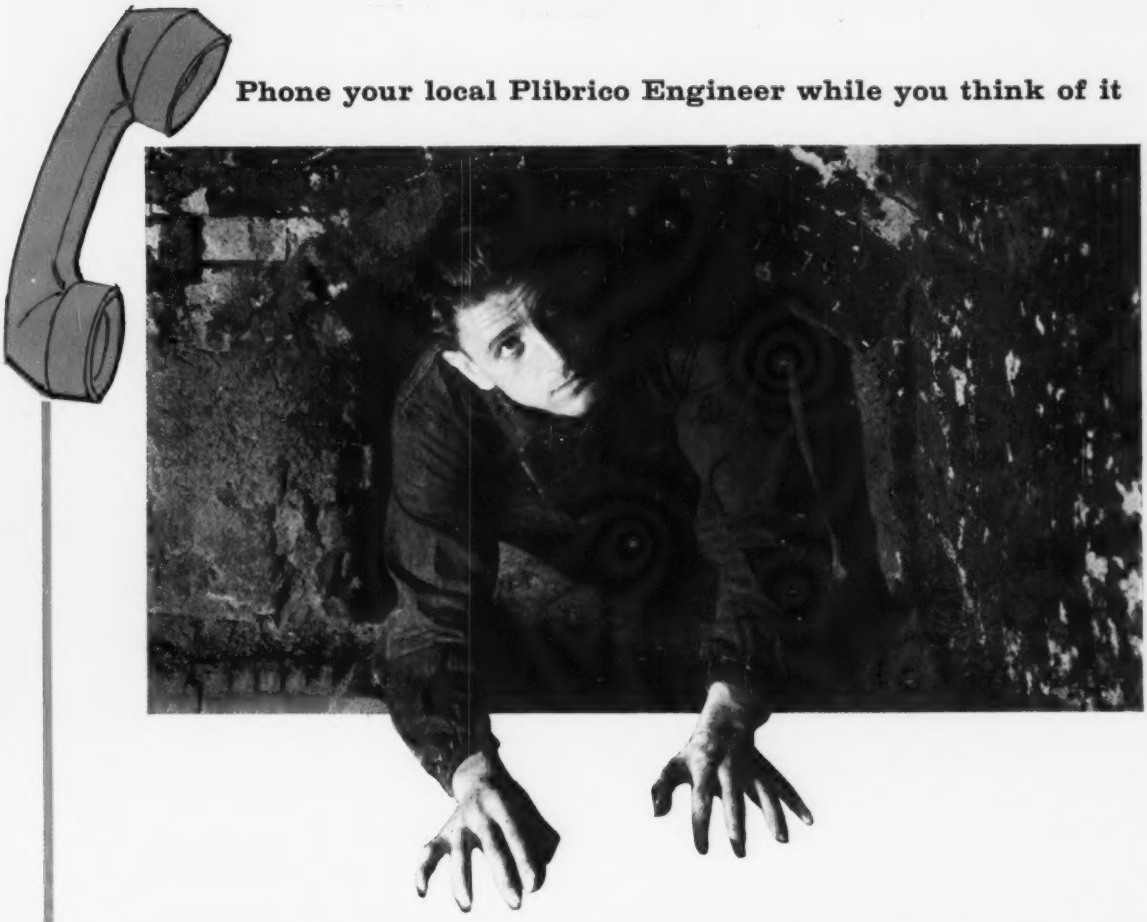
Just circle key numbers on the Reader Service card, page 121, to get complete product story

### Disconnect serves as thermocouple head

**53** • Base and terminals of thermocouple heads and connectors are imbedded in waterproof and weatherproof molded-neoprene body. There are no threads to corrode or bind. You simply make or break circuit by hand.

Disconnect can be used for thermocouple assemblies, as thermocouple

**Phone your local Plibrico Engineer while you think of it**



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CONTROL SYSTEMS
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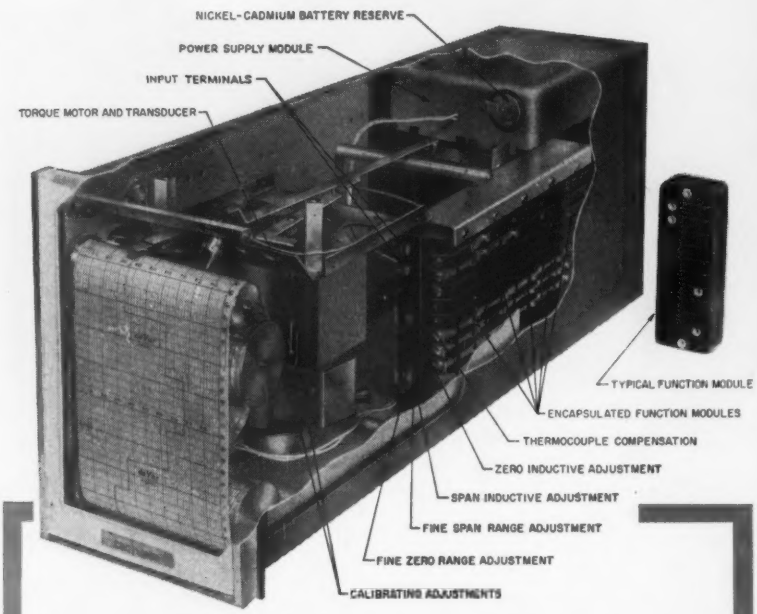
# DC INPUT ISOLATION AND NOISE-FREE DC OUTPUT




The unique DE VAR potentiometer/receiver recorder is particularly suited for Strain-Gage Transducers, Thermocouples and Resistance Bulb Elements. The isolated input circuit rejects high common-mode noise without resorting to input balancing. The DC output signal is sufficiently noise-free to feed data loggers or computers. In addition, a low noise, high frequency carrier signal is available for drift-free operation of controllers and alarms.

- Exclusive inductive zero and span adjustment — continuously variable from 0-5 mv to 0-50 mv.
- Complete solid state circuitry — including unique transistor chopper.
- Battery reserve — eliminates costly down time.
- Full scale rectilinear writing — with 1, 2, or 3 pens.

Our Technical Bulletin R-301 describes the most advanced miniature recorder now available —

Write today

DE VAR SYSTEMS INC.
494 GLENBROOK ROAD
GLENBROOK, CONNECTICUT
A DIVISION OF GENERAL KINETICS CORPORATION

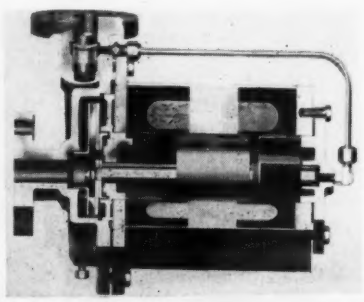


head or as lead-wire junction up to 16-ga wire sizes. All parts are interchangeable. Connector pins are sized to eliminate possibility of reverse polarity.—Gay Sales Company

## For fast installation: self-locking jacketing

**31** • Insulated lines can be aluminum-sheathed without special tools, with less effort. One man can install this jacketing, even on overhead lines. It's precut and prerolled. Natural tension of the rolled sections holds jacketing in place until it's fastened. Sections interlock to form a continuous seal; join them with pop rivets, screws or bands.—Premetco

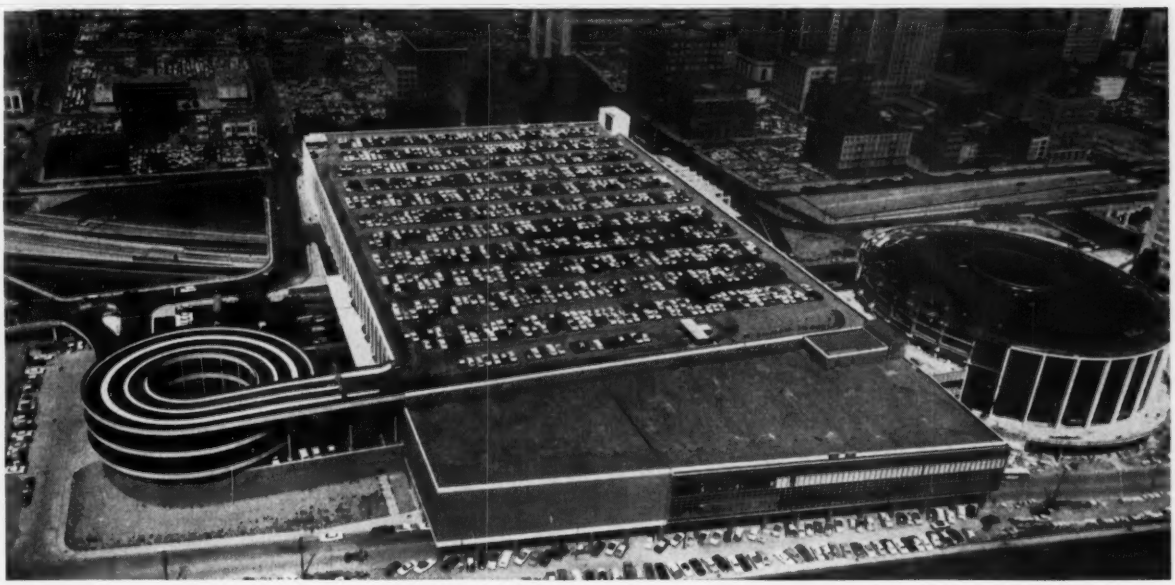
Just circle key numbers on the Reader Service card, page 121, to get complete product story



## Automatic thrust balance ups bearing life

**21** • Leakproof canned pumps feature thrust-balance design combined with larger bearings, tripled radial

# WHAT A HALL!



This is Cobo Hall, Detroit's new exhibition building—one of the largest of its kind in the world. The structure is three stories high and has 51 acres of floor space. Inside, there are 32 meeting rooms, a cafeteria, a coffee shop, a banquet hall that doubles as a ballroom and four huge exhibition areas—one area has about 300,000 square feet of exhibit space. ☐ The Hall is so big that they used 330 tons of USS NATIONAL butt-welded and seamless pipe in sizes ½" through 24" O.D. just for the heating and air conditioning systems. They run steam through the heating system at 300°F. and 35 psi. The air conditioning (system) can carry 10,000 gallons of water a minute at 65 psi. ☐ When you need quality pipe and tubes for power, heating and air conditioning installations—order USS NATIONAL. For information or technical assistance, write National Tube Division, United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

*USS and NATIONAL are registered trademarks*

**National Tube Division of United States Steel**

Columbia-Geneva Steel Division, San Francisco, Pacific Coast Distributors
United States Steel Export Company, New York

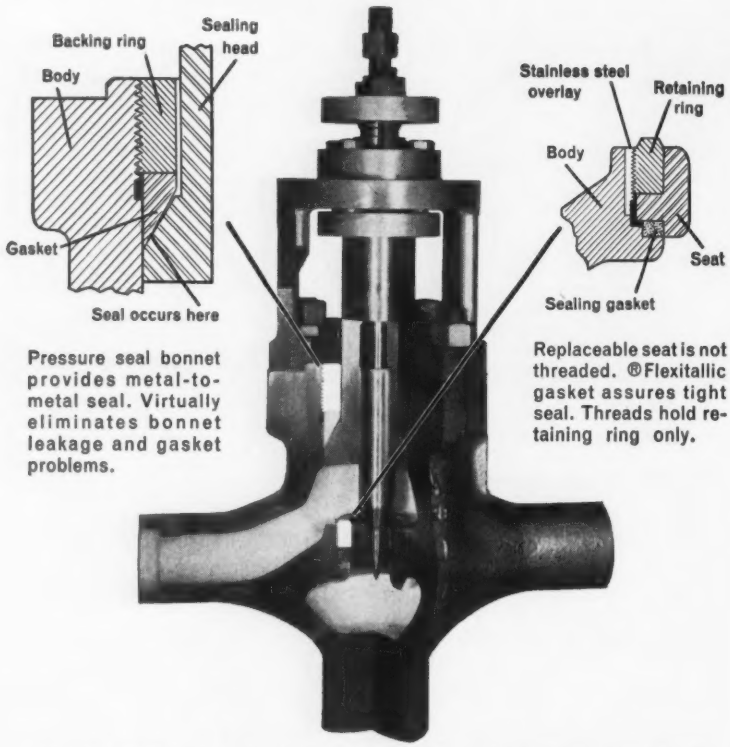
This mark tells you a product is made of modern, dependable Steel.



For more facts circle 277 on Reader Service card, p 121

ROCKWELL-REPUBLIC

# *High pressure globe valve withstands pressure drops up to body ratings*




Pressure seal bonnet provides metal-to-metal seal. Virtually eliminates bonnet leakage and gasket problems.

Replaceable seat is not threaded. ®Flexitallic gasket assures tight seal. Threads hold retaining ring only.

Rockwell-Republic high pressure globe valves are available in 1½", 2", and 3" sizes for 1500, 2500 and 4500 psi standards. In addition to removable seat and pressure seal bonnet, these valves are available with bolted bonnets and quick-change trim. For more information about this and other Rockwell-Republic components and systems, just mail the coupon below. RF-23

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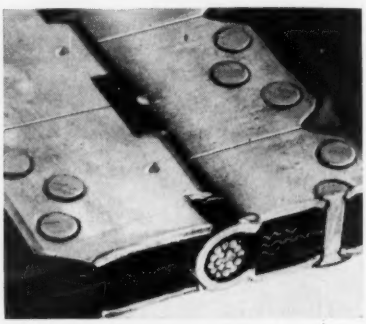
2240 Diversey Parkway, Chicago 47, Illinois

## Equipment news

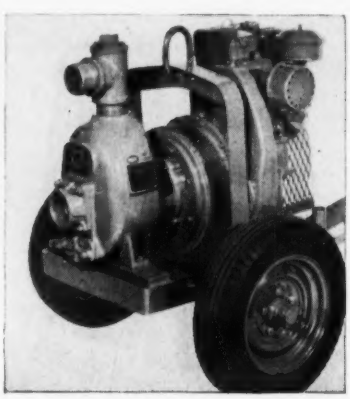
bearing surfaces. Result, according to maker: extra-long bearing life. An oil-filled stator cavity dissipates heat from motor windings so motor lasts longer. Series-G pumps have been field-tested in 100 installations.—Fostoria Corporation, Chempump Div



### Belt splice

**41** • This splice handles belts with interwoven carcass. Splice is installed in one piece for a tight, leakproof yet flexible joint, says maker. As conveyor operates, hinge plate separates into sections at prescored notches to fit trough curvature.

Method of fastening: pointed rivets which separate but don't cut or weaken belt fabric. Available for belts 1/32- to 1-in. thick, up to 72-in. wide.—General Splice Corporation

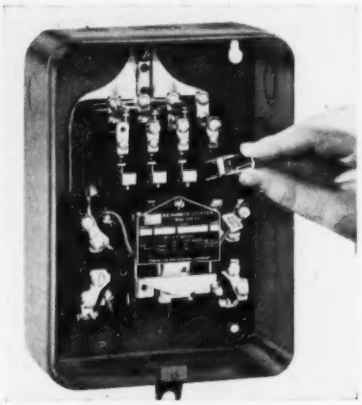


### Diesel-powered centrifugal pumps are cooled by air

**24** • Self-priming centrifugal pumps powered by diesel come in 2-, 3-, 4- and 6-in. openings. Capacities range from 15,000 to 90,000 gph. Diesel

Begins on page 132

engines are offered in 4-cycle air-cooled crank-start types; electric starters are optional. Pumps mount on high-speed trailers with pneumatic tires, shown, skids or conventional-wheel mountings.—Rice Pump & Machine Company



## Size-00 motor starter features accessible contacts

**28** • No tools at all are needed to remove this unit's movable contacts. They snap in and out, above. A screwdriver will remove stationary contacts.

NEMA size-00 motor starter, rated at two hp, handles low-load applications—compressors, pumps, blowers, conveyors. It operates with a ball-bearing-guided moving assembly made up of magnet and contacts. Straight-line vertical operation cuts danger of accidental closing.—Federal Pacific Electric Co

Just circle key numbers on the Reader Service card, page 121, to get complete product story

## Pump handles thick and thin liquids

**60** • Internal-gear rotary pump handles viscosities from thin to 80,000 ssu. Pump uses only two moving parts—design results in greater pumping capacity in less space. Sizes range from ⅜ to 8 in. for pressures to 200 psi and capacities from 1.5 to 1050 gpm.—The Deming Company


ROCKWELL-REPUBLIC

# V-5 gauges combine small size with big-gauge readability

**TRY THIS "CUTOUT TEST"**

For a true demonstration of the readability of Rockwell-Republic V-5 gauges, cut out the actual-size photo at the right. Mount it on any wall or panel board. Step back and see how easily the scale can be read, even from 10 or 12 feet away!

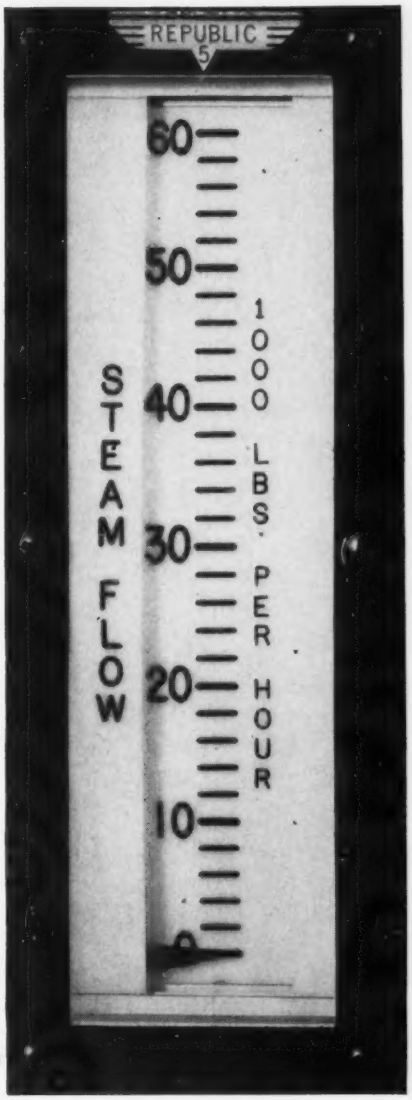
**BIG-GAUGE ACCURACY, TOO**

Compact V-5 gauges are equipped with electric receivers or full sized diaphragms, bellows, and helixes for maximum accuracy and sensitivity. Yet these Rockwell-Republic gauges require one-fourth the panel space needed for standard gauges.

**GROUP MOUNTING INCREASES VERSATILITY**

As many as eight gauges can be grouped in a single mounting case. Types can be mixed to meet individual panel requirements. Mounting is simple, too. Just a panel cutout is required in most cases.

There's a V-5 gauge for almost every process measurement. Mail the coupon today for the 12-page bulletin on these easy-to-read gauges, and for available literature on other Rockwell-Republic instruments, controls, and valves. RF-22

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For more facts circle 279 on Reader Service card, p 121

# Let's face it!

## HAVE YOU A DISASTER PLAN FOR YOUR PLANT?

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Let's face it... the threat of war and the atomic bomb has become a real part of our life—and will be with us for years. Fires, tornadoes and other disasters, too, can strike without warning.

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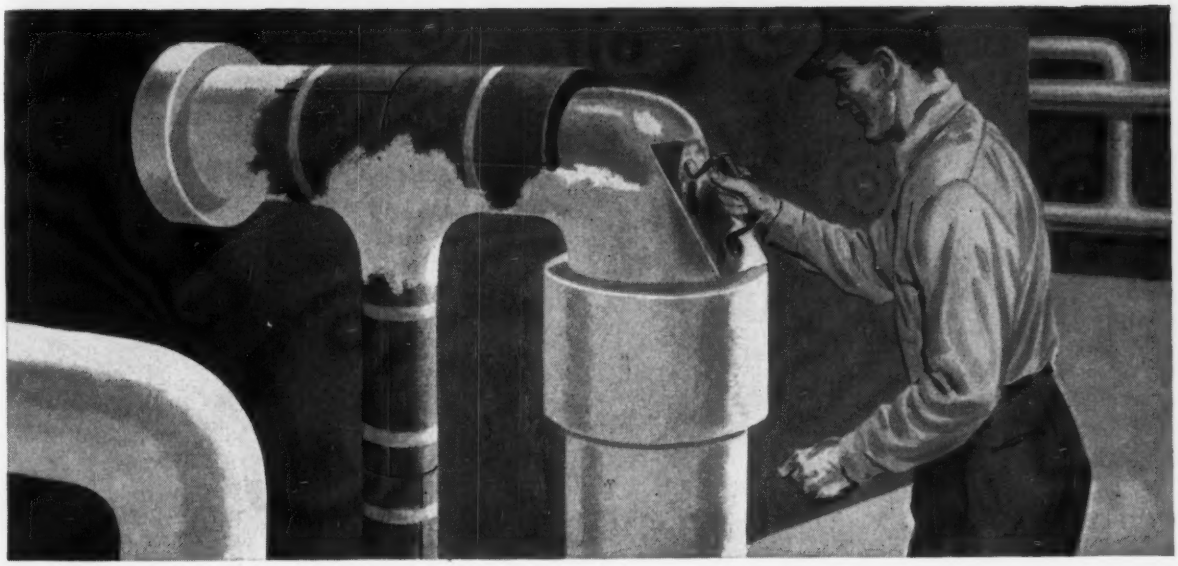
☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

***Act now . . . check off these four simple points . . . before it's too late.***



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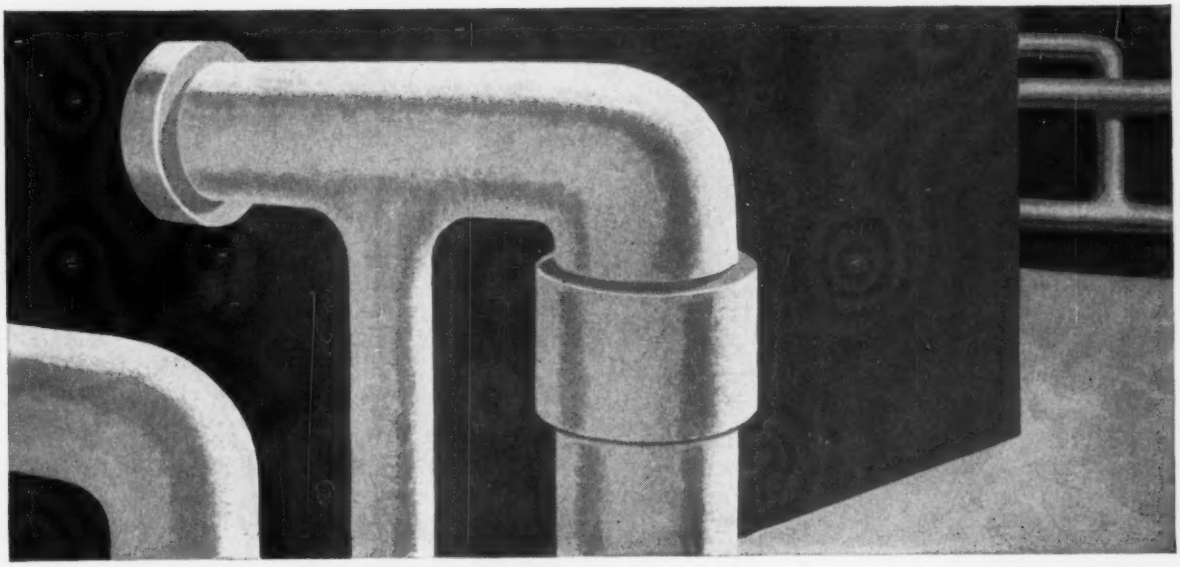

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- Highly efficient! Effective insulation at temperatures up to 1000 F.
- For outdoor installations! Quick-setting, withstands rain and moisture two hours after application. Prevents rust!
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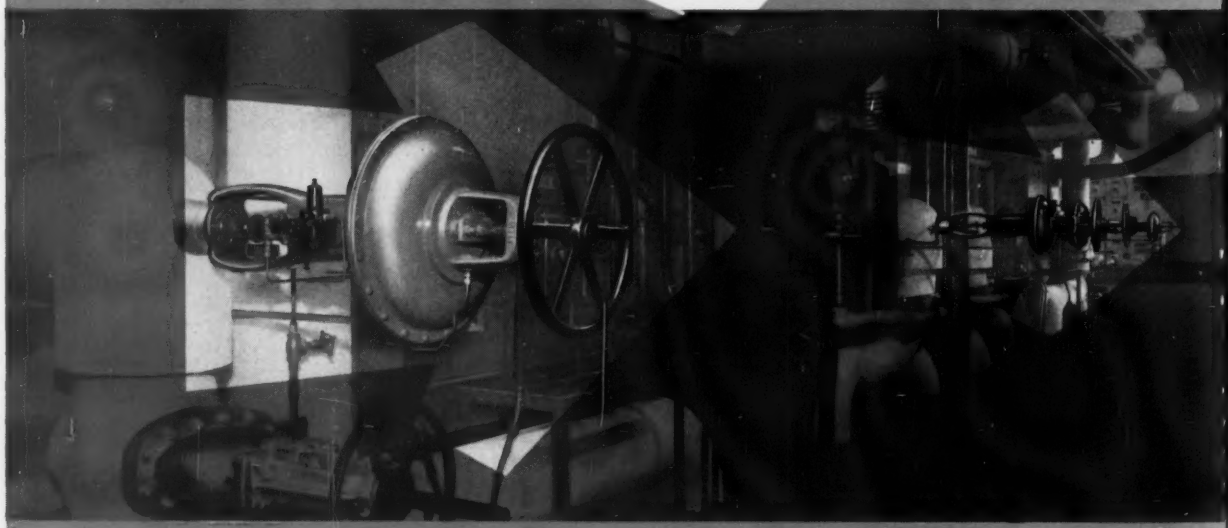
For more facts circle 281 on Reader Service card, p 121

An extensive installation of Liquid Level Controllers and Control Valves with Positioners to control condensers and low pressure heaters in a new generating station.



Mesconites Angle Valves installed in the new power plant of a large eastern utility.

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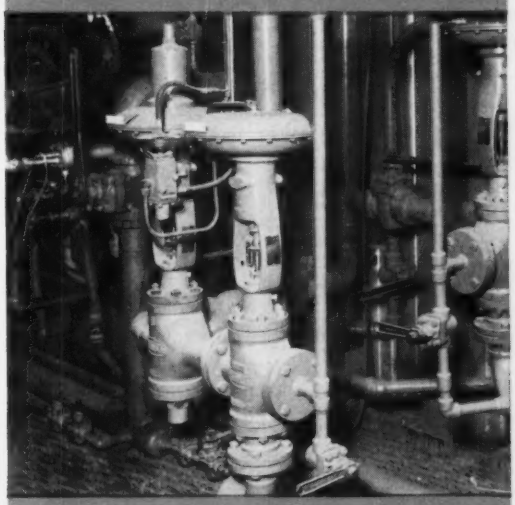
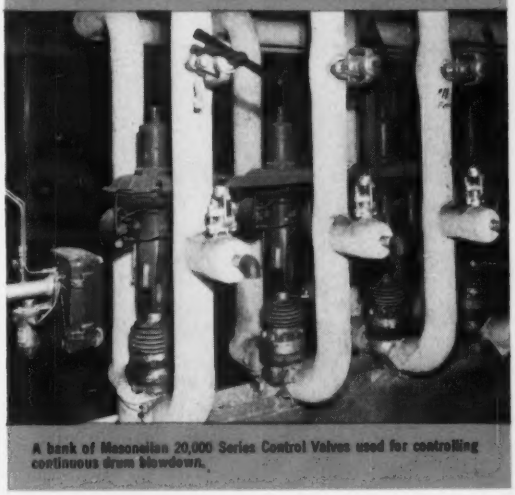
MNI-11

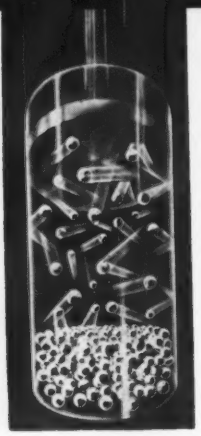
Masoneilan Model 777 Angle Valve, with extended outlet acting as nozzle liner, used as a drain bypass control valve.

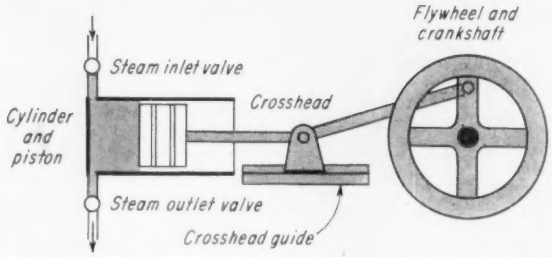


Masoneilan Three-Way and 10,000 Series Valves used on gas firing and ignition step service.

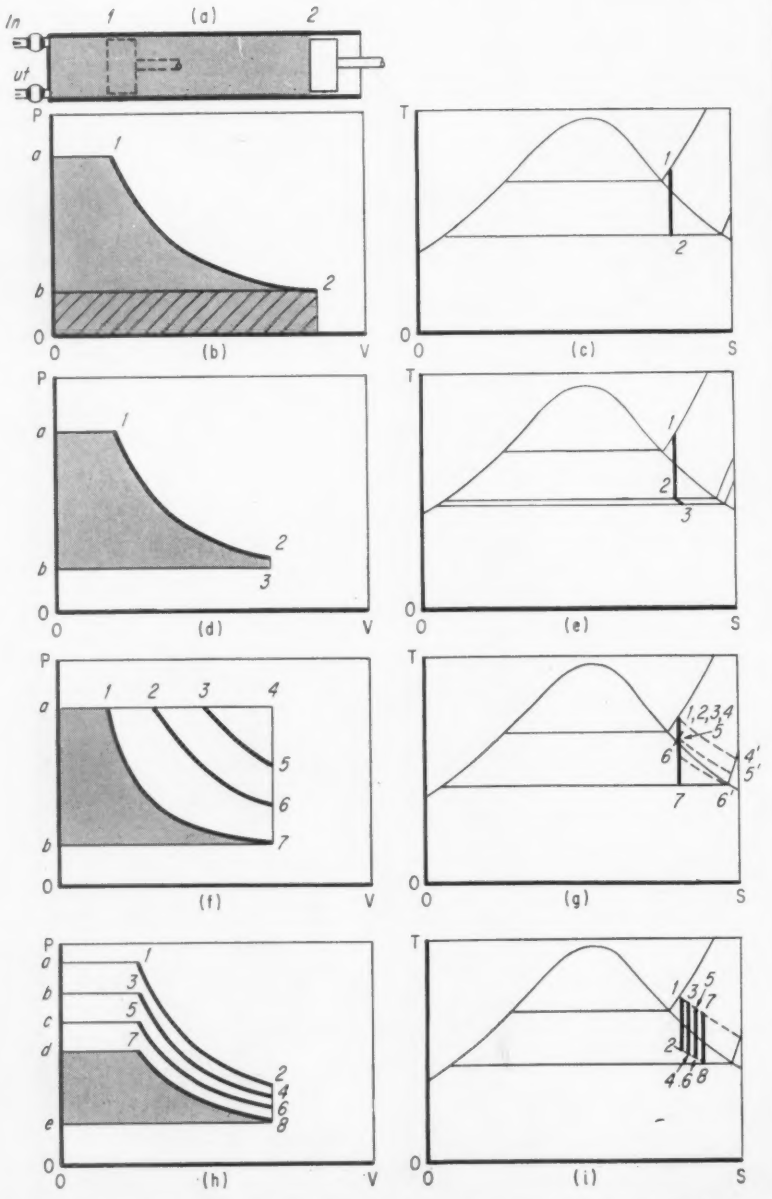


A bank of Masoneilan 20,000 Series Control Valves used for controlling continuous drum blowdown.






1 Separate inlet and outlet valves control admission and exhaust of steam from cylinder. Flywheel smooths engine's energy output



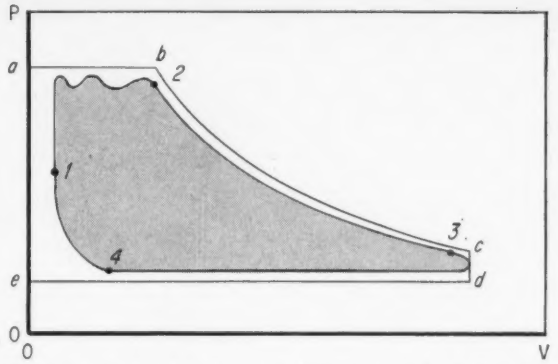

2 Output of zero-clearance steam engine depends on two points: method of controlling flow in and out of cylinder; extent of expansion. Throttling drops efficiency

**For more than a century the reciprocating steam engine was the only method of producing mechanical work from heat. This prime mover had to solve special problems to achieve high thermal efficiency. Let's learn . . .**

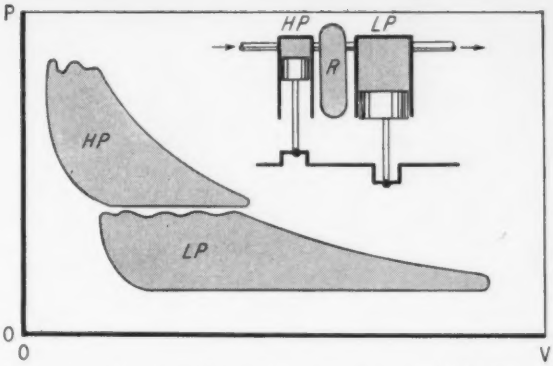
# How steam engines produce work

Supreme prime mover of the 19th-C industrial world, the reciprocating steam engine now serves only low-capacity special applications. Despite its limited use today, the steam engine raises special thermodynamic problems that will be of interest to us—so let's take a brief look at its theory and methods of control.

**Operation.** The reciprocating steam engine has some features in




**3** Actual output of engine with clearance is markedly less than output of ideal zero-clearance engine because of many losses




**4** Compound steam engine may have two or more cylinders receiving successively lower-pressure steam. It develops large capacity

By B G A SKROTZKI, Associate Editor

common with the reciprocating air engines we studied in Parts 15 and 16, January and February 1958. Fig. 1 shows elements of the simple single-acting steam engine. A piston moves back and forth in a cylinder under the force developed by steam entering and leaving the cylinder.

Force on the piston varies during the working stroke as the steam expands. To smooth the rate of shaft-work output and store work to push out spent steam, the piston drives a heavy flywheel through a reciprocating crosshead and crankshaft. Mechanical energy to the flywheel goes mostly to drive the load through the shaft, but part of it removes exhaust steam from the cylinder.

Inlet and outlet steam valves must be synchronized with piston motion to admit and discharge steam as needed and hold shaft speed required by the load, either variable or constant.

**Engine cycle.** Fig. 2*a* and *b* show idealized pressure-volume variations of a piston and cylinder with zero clearance. At *a* in Fig. 2*b* the piston is at the head end of the cylinder with zero volume of steam in the cylinder. Inlet valve opens and admits steam which fills the expanding cylinder volume and moves the piston to point *1*; this is called *admission*. Here the inlet valve closes and the steam begins expanding at constant entropy to the exhaust pressure at *2*. At *2* the outlet or exhaust valve opens and the piston reverses direction, moved by energy stored in the flywheel. Piston pushes the low-pressure steam out of the cylinder until it reaches *b* where cylinder volume reduces to zero. The inlet valve then opens and engine cycle repeats itself from *a*.

What do the areas on the P-V chart mean? To begin with, this is not a thermodynamic-cycle chart because all the lines are not processes in the usual sense. Line *a-1* applies to a varying mass of steam entering the cylinder and *2-b* to a varying mass leaving the cylinder. However, *1-2* is a process applying to a constant mass of steam. This corresponds to *1-2* on the T-S chart in Fig. 2*c*. The other engine events cannot be shown on Fig. 2*c*.

On the P-V chart, line *a-1* measures pressure acting on the piston. Its length (admission) measures the distance through which the force acts, so the product *PV* measures *work* done by the entering steam *on the piston*, the area under line *a-1*. This equals flow work of the entering steam.

The area under *1-2* measures *work* done by the expanding steam at constant entropy *on the piston*. The hatched area under *2-b* measures *work done by the piston* on the steam in forcing it out to exhaust, which is also the flow work of the leaving steam. Summing up the areas, we find the net gray area *a-1-2-b* measures the net work output of the piston, or net work done by the steam flowing through the engine. Again note that this is not a thermodynamic cycle, but a measure of engine events. This type of P-V chart is called an *indicator card* of the engine.

Assuming one lb of steam flows through the reciprocating engine:

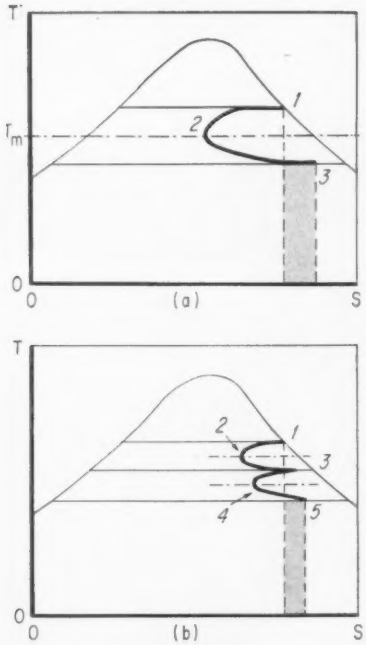
$$W = W_1 + W_2 - W_3 = \frac{P_1V_1}{J} + E_1 - E_2 - \frac{P_2V_2}{J} = H_1 - H_2 \quad (1)$$

This shows that theoretically the ideal reciprocating engine develops the same work as a steady-flow engine like the turbine.

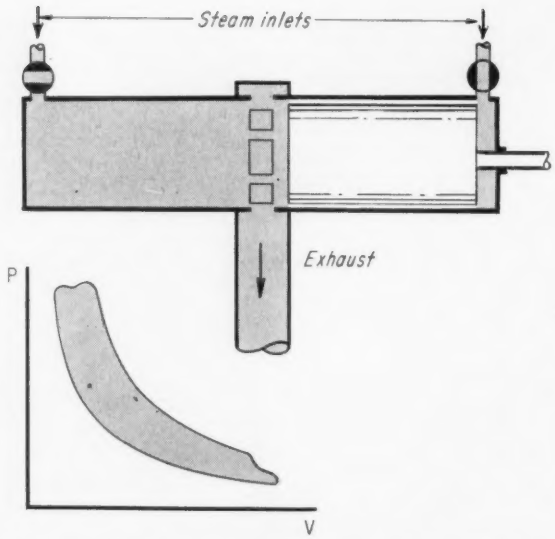
**Engine factors.** Toe of the indicator card at state *2* develops little work —additional stroke needed to realize this small increment does not pay for itself in the practical engine; friction losses may more than eat up the small work produced. As a compromise, the *incomplete expansion* engine is used, Fig. 2*d* and *e*. Here the piston completes its stroke at *2* with the pressure higher than the exhaust pressure at *3*. The exhaust valve opens at *2* and the excess pressure makes part of the steam in the cylinder blow down to the exhaust pressure at *3*. The piston then forces the remaining steam out of the cylinder along *3-b*.

Throttling the steam from $P_2$ to $P_3$ raises the entropy and so the unavailable energy, area under *2-3* in Fig. 2*e*. This is less efficient than the complete expansion engine, but a good practical compromise.

Most engines run at essentially constant speed. How, we may ask, can output be varied? Fig. 2*f* and 2*g* show how this may be done by changing the *cutoff* to vary *W* per cycle. Point where the inlet valve closes, *1, 2, 3* or *4* (or in between), is the cutoff. This is the end of admission of steam to the




**5** Initial condensation of steam entering engine distorts expansion path of the steam and raises unavailable energy




**6** Uniflow steam engine has piston filling half its cylinder and exhaust ports at cylinder center. Double-acting engine takes in steam at both ends but exhausts only through center ports

cylinder and the start of expansion *1-7*, *2-6* and *3-5*. The engine with cutoff at *4* is a *full-admission* engine and does not expand the steam at all. Expansion shortens with increasing admission; Fig. 2*g* shows the increasing throttling that takes place as exhaust valve opens. We get increasing work per cycle at the expense of poorer efficiency. In Fig. 2*g*, *4′* represents the steam state at exhaust pressure $P_7$, as do *5′* and *6′* from the corresponding expansion ends, *4*, *5* and *6*.

Fig. 2*h* and *i* show the lesser used inlet-pressure throttling to control engine output. This engine has a fixed cutoff, but as the load drops the inlet steam pressure is throttled to reduce $W$ per cycle. This engine proves rather inefficient because there's throttling at both ends of the expansion process, but its valve gearing is usually quite inexpensive.

In practice, net area on indicator cards is called the indicated horsepower of the engine and may be figured as:

$$Ihp = \frac{P_m LAN}{33{,}000} \qquad (2)$$

where

$P_m$ = mean effective measure, psf
$= W/V_d$
$W$ = work, ft-lb per cycle
$V_d$ = cylinder volumetric displacement, cu ft
$L$ = piston stroke, ft
$A$ = piston area, sq ft
$N$ = number of engine cycles per min

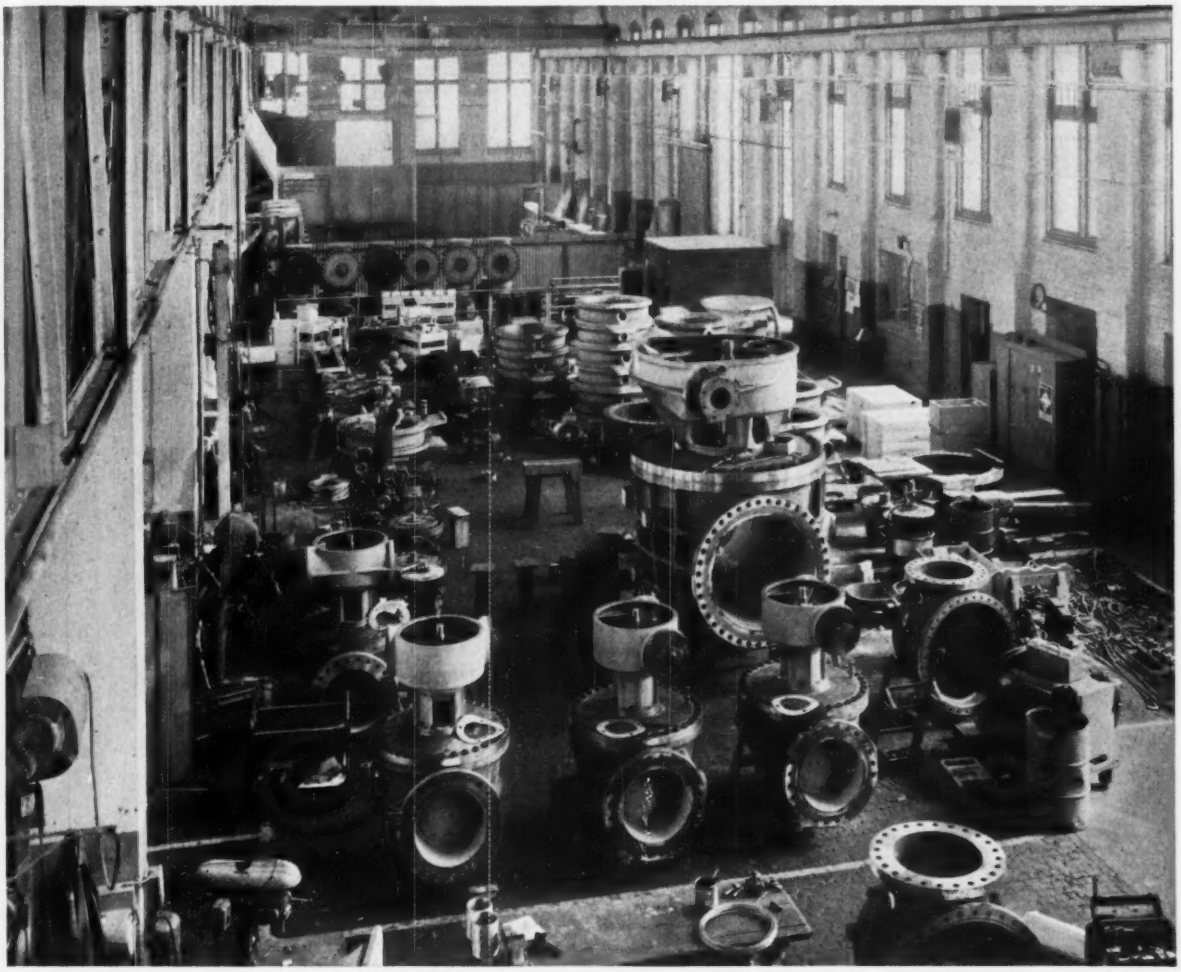
**Actual engine.** Fig. 3 compares an actual indicator card with an ideal conventional card. As expected, net area of the actual card is less than the ideal—meaning less work per cycle. At *1* the piston reaches the end of its head-end stroke and the inlet steam valve opens, admitting steam to the cylinder and raising the pressure rapidly. The actual engine has a clearance volume $V_1$, depending on design of valve, ports and connecting passages. As the piston recedes on its working stroke, steam flows into the cylinder. Pressure fluctuates because of the sudden admission and uneven flow. At *2*, the cutoff, inlet valve closes and steam expands to a lower pressure. Expansion is not at constant $S$ because of heat transfer between cylinder walls and the steam—more of this later in this article.

At *3*, before the end of the piston working stroke, the steam-exhaust valve opens and the steam begins blowing down to the exhaust pressure. On the exhaust stroke, piston forces the steam out of the cylinder at about constant pressure. At *4*, exhaust valve closes and piston compresses the entrapped cushion or clearance steam to point *1* where inlet valve opens and cycle repeats.

Note that admission pressure is less than the steam pressure $P_a$, expansion lies below the ideal *b-c*, and cylinder pressure $P_4$ is higher than exhaust pressure $P_e$. Irreversible processes of friction, heat transfer and pressure loss contribute to efficiency losses in the steam engine.

**Cylinder condensation.** The expansion process of an engine often lies close to $PV = C$, but it's not a constant-temperature process. Fig. 5*a* shows its nature. As steam enters the cylinder at *1* it is hotter than the walls, and if the steam is saturated, a considerable part condenses as shown by the horizontal process line. But as the steam expands, its temperature drops to $T_m$ at state *2* where it's the same as the walls. During this part of the expansion, heat transfer to the wall dwindles, dropping to zero. Continued expansion puts steam temperature below that of the wall $T_m$. Then heat

# ALLIS-CHALMERS



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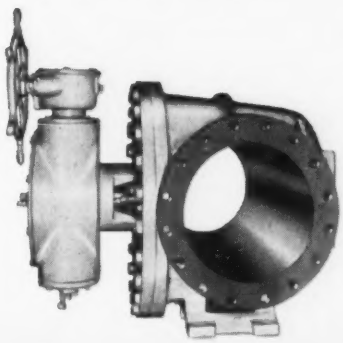
*Allis-Chalmers offers today's only complete, perpetual rotary-valve stocking program, assuring you fastest delivery, thanks to "off-the-shelf" availability. For help anytime, contact your nearby A-C valve representative, district office, or simply write to* **Allis-Chalmers,** *Hydraulic Division, York, Pa.* A-1395



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Begins on page 148

retransfers from wall to steam as the steam grows colder. Since the area under *1-2* is the same as area under *2-3*, net effect of this complex expansion increases the entropy and the unavailable energy as shown by the gray area on Fig. 5*a*.

To raise engine efficiency, cylinder condensation can be reduced by several methods: superheating, valving, compounding, a uniflow engine.

*Superheating.* Fig. 5*a* assumes steam initially saturated and ready to condense on the slightest cooling. If steam is initially superheated, initial cooling will drop its temperature but not form the moisture which aids heat transfer. Superheating, of course, also offers the thermodynamic advantage of higher thermal head. The generally higher temperature of the whole cycle also reduces exhaust moisture.

*Valving.* Designing the valves to shorten contact of steam with metal walls of passages will reduce heat losses. Therefore the cylinder condensation caused by loss of internal energy will be reduced as well.

*Compounding.* A compound engine, Fig. 4, splits steam expansion into two processes, helps reduce initial condensation. Here steam first expands in a high-pressure cylinder, exhausts to an intermediate receiver *R*, flows into the low-pressure cylinder for final expansion, then to exhaust. Both pistons work on a common crankshaft.

Compounding shortens the temperature range within each cylinder, reducing the opportunity for heat transfer as shown in Fig. 5*b*. The gray area measuring rise in unavailable energy is much less for the double expansion than the single expansion between the same pressure levels. Compounding also helps in building engines with large capacity when work output is split between two or more pistons for the same steam flow.

*Uniflow engine,* Fig. 6, achieves low cylinder condensation essentially by making steam "flow" in one direction through the cylinder. The double-acting engine has a piston that fills one half of the cylinder. In the position shown, inlet valve on the right has just opened and steam enters the right-hand clearance volume. During

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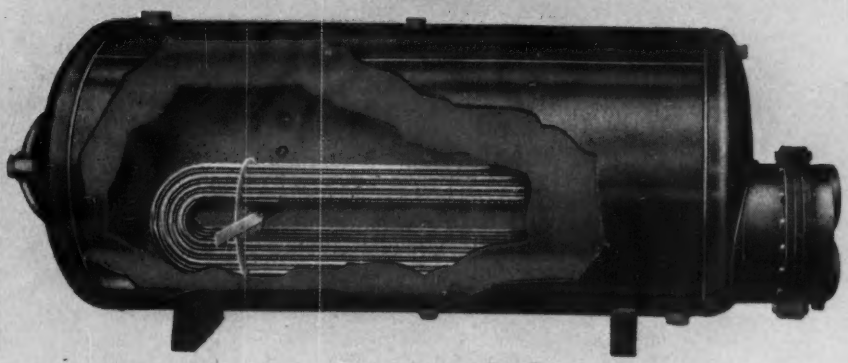

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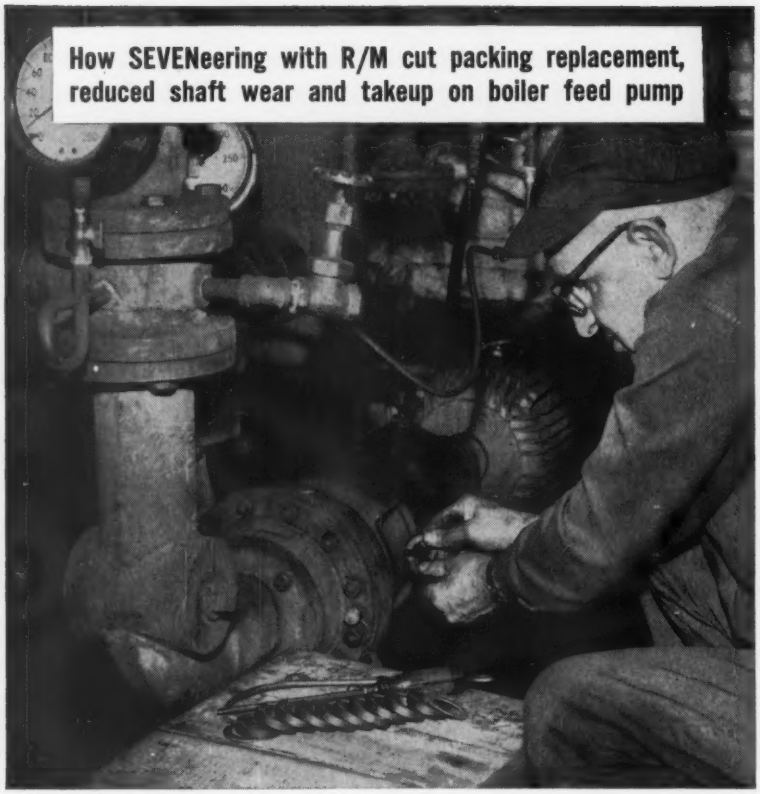
The Pre-Krete factory-installed lining you specify today will be in perfect condition in 1966 . . . or P-K will repair or replace it free of charge! This new five-year unconditional, *un-prorated* guarantee covers materials and labor. It applies to all factory lined P-K storage water heaters. • After five years? Pre-Krete cures in hot water, gets better as it ages. Chances are it will last almost indefinitely. • A Pre-Krete rust- and corrosion-resistant hydraulic cement lining doubles the life of a plain steel heater, yet costs only slightly more. Special additives make the ¾" coating extra durable. It doesn't chip, crack or flake even at temperatures up to 900°F. And, there are no weak spots or "holidays", because Pre-Krete is always uniform — a result of precision blending. Maintenance costs, of course, are lowered appreciably. • P-K Pre-Krete lined storage water heaters are economical to buy, install and operate. • Designs are advanced in concept and fabrication techniques meet all ASME specifications. • We'll gladly send you our descriptive catalog and more information. Write Patterson-Kelley Co., Inc., 86 Burson Street, East Stroudsburg, Penna.

**Patterson Kelley**

Water Heater Division




## Only 2 repackings a year with R/M 1845 "versi-pak"® — more than 26 with former boiler feed pump packing

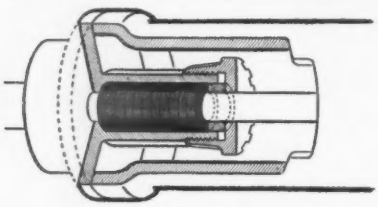
Poor packing life, expensive shaft wear, and constant takeup were all problems harassing the boiler room engineer at Ludlow Papers, Ware, Mass., in maintaining a boiler feed pump operating at 325-350°F and 3450 rpm.

The life of the braided asbestos packing formerly used was only 1-2 weeks, the shaft had to be replaced in less than a year, and too frequent packing takeup was necessary.

Maintenance Specialties Co., an R/M Big 7 Packing distributor, solved all problems fast with R/M 1845 "versi-pak" nonjacketed plastic packing. This Big 7 Type No. 1 Packing, made from long asbestos fibers combined with low-friction compounds and nonleaching lubricants, not only extended packing life to 5-6 months, but also resulted in negligible shaft wear and packing takeup. And R/M "versi-pak" costs less per set than the former packing.

Ludlow Papers, one of the largest manufacturers of gummed and coated label papers, specialty papers, reinforced papers and tapes, plastic film, and plastic coated materials, is one of many concerns Seveneering with R/M to meet their packing needs.

Our Big 7 Packing Selection Chart is a helpful guide to the selection and application of R/M Packings for all types of equipment. Write for your copy today. And the next time you need packings, see your authorized R/M Big 7 Packing distributor. He has the technical background and the packings to solve your knuckle-busting problems.



Ground-in lubrication, high resistance to heat, materials handled and pressure make R/M Big 7 Type No. 1 Packings ideal for pumps handling water, steam, chemicals, foods, beverages, oil and solvents.

**R/M's Big 7 Packing Types meet 95% of all packing needs, are sold exclusively through authorized R/M distributors**

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RAYBESTOS-MANHATTAN, INC.
BIG 7 PACKINGS
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS




Begins on page 148

the early part of the leftward piston admission stroke, right inlet valve closes and the right-hand steam starts expanding. During the right-hand admission stroke the piston closes off the center exhaust ports and starts compressing the left-hand cylinder cushion or clearance steam.

While the right-hand steam expands, the left-hand steam compresses. Before the leftward stroke ends, the piston uncovers the exhaust ports for the right-hand steam and it blows down to exhaust. Just before completion of the stroke the left-hand admission valve opens to admit steam to the left-hand piston face. Actions in both ends of the cylinder then take place in the reverse order.

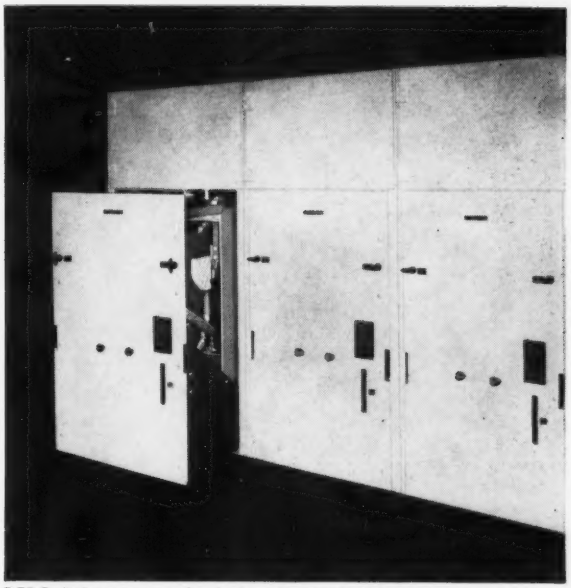
Fig. 6 shows the indicator card for the left-hand end of the cylinder; the right-hand end has a similar one.

In this engine the inlet ends of the cylinder generally remain hotter than the center exhaust area. This reduces the average temperature differentials between steam and cylinder and so the initial condensation with its energy losses. Avoiding the *flow* of hot steam over relatively cold surfaces helps this engine achieve its high efficiency.

*Next month we study refrigeration systems using vapors.*

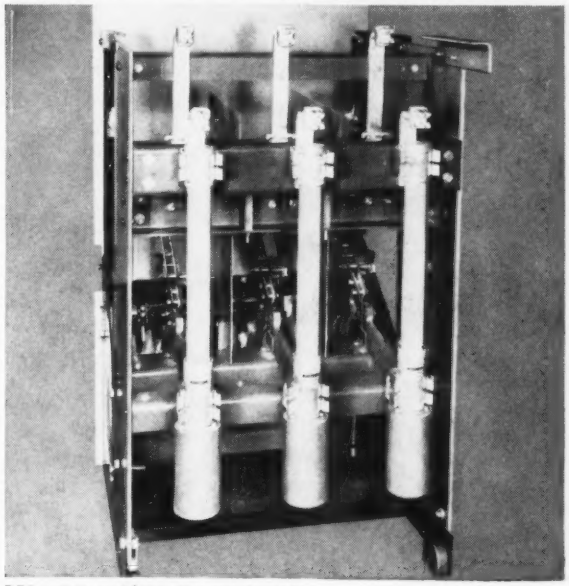
*"I don't know where it came from but it does seem to keep them in front of the boilers."*

# New...Low-Cost, Drawout DFS Metal-Enclosed Load-Interrupter Switchgear



DFS Switchgear comes in single units or switching centers, as shown, for service entrances, transformer primary or feeder switching.

DFS drawout switch and fuse element is easily levered into cell.



DFS switch and fuse element, rear view.

Type DFS Metal-Enclosed Switchgear—*drawout fused switch*—provides compact, low-cost power switching for high voltage circuits in commercial buildings, institutions, and small industrial plants. DFS Switchgear meets a wide range of applications—with fault interrupting ability up to 250 mva at 4160 volts and 500 mva at 13,800 volts . . . load break rating 600 or 1200 amperes . . . full fault closing ability of 60,000 amperes for 5 kv and 40,000 amperes for 15 kv.

DFS Switchgear provides these major advantages:

**Drawout design** assures completely safe switch inspection and fuse replacement.

**Component design versatility** meets a broad range of applications, including automatic transfer and remote control.

**Simplified metal-enclosed construction** presents compact, modern appearance.

**Maximum service reliability** assured by extensive High Power Laboratory design-proving tests.

For full information call your Westinghouse representative, or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pa., for Descriptive Bulletin 32-750. *You can be sure . . . if it's Westinghouse.*

J-61011-R1

Westinghouse

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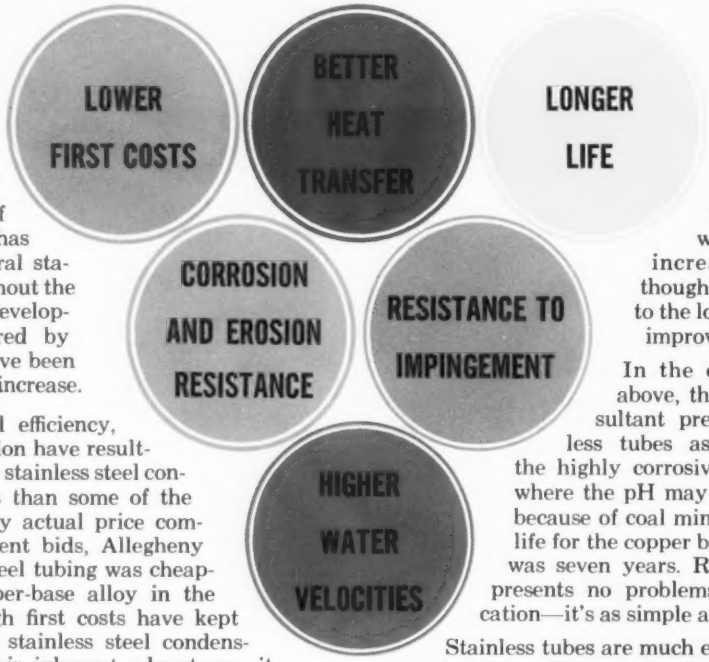
# NEW DEVELOPMENTS IN ALLEGHENY STAINLESS STEEL CONDENSER TUBES MEAN




In the last three years, over 3 million feet of stainless steel tubing has been installed in central station condensers throughout the United States. New developments, many sponsored by Allegheny Ludlum, have been responsible for this increase.

Automation, improved efficiency, and increased production have resulted in lower prices. Now stainless steel condenser tubes cost less than some of the copper alloy tubes. By actual price comparisons on some recent bids, Allegheny Type 304 Stainless Steel tubing was cheaper than a usual copper-base alloy in the same diameter. If high first costs have kept you from considering stainless steel condenser tubing with all their inherent advantages, it will pay you to re-investigate.

Increased operating data have shown that the in-use heat transfer rates on condenser tubes are much superior to the published data of a decade ago. Exhaustive tests made at a condenser completely re-tubed with Allegheny Type 304 Stainless Steel in May 1958 showed that the actual over-all heat rate on the turbine was improved over the 88-10-2 copper tubes previously used. Part of the answer is the thinner wall possible in the stainless tubing, 22-Bwg, compared with the 16-Bwg copper alloy tubing formerly used.

The superior strength of stainless allowed these thinner walls. In spite of the larger inside diameter, cooling water velocity through the tubes averaged ½ FPS more in stainless, although the pumping facilities were not changed. This increase in velocity, even though the ID is larger, is due to the lower flow resistance and improved interior cleanness.

In the condenser mentioned above, the utility and their consultant predict the life of stainless tubes as thirty years despite the highly corrosive river water involved where the pH may vary from three to six because of coal mine drainage. Previously, life for the copper base tubes formerly used was seven years. Re-tubing with stainless presents no problems, calls for no modification—it's as simple as re-tubing with copper.

Stainless tubes are much easier to clean than copper alloy tubes. They are harder and tougher. The mud and slime do not cling to the surface. With copper tubes, it was impossible to clean these condenser tubes without using oversize cleaning plugs which would have affected tube life. Practical cleanliness of copper tubing averages less than 60%. After re-tubing with Allegheny Stainless, one shot with nylon brushes restored cleanliness to the as-new condition.

Another major trend is the partial use of stainless tubes to resist excessive steam-side erosion. Many condensers are being specified or re-tubed with stainless tubes in the outer banks to resist blasting action or steam impingement. Generally, approximately 5% of the total tubes are specified stainless for the periphery. Even here, 22-Bwg stainless is usual where 18-Bwg or less is necessary in the copper alloys.

Retubing the air removal section of this condenser with Allegheny Stainless Tubes eliminated attack by the high ammonia content of the non-condensibles.

Another trend is the use of stainless in the air cooler or residual condenser section. Copper tubes tend to stress crack and fail because of the ammines used for water purification. Under these conditions, stainless tubes remain unaffected even under excessive build-up of ammonia in the non-condensibles.

On the horizons in heat transfer equipment design is an all stainless steel condenser that will result in an overall size reduction. With the higher strength and the less resistance to water flow of stainless tubes, water velocity through the tubes can be doubled. Erosion and corrosion can be virtually eliminated. Right now, several consulting firms are evaluating this latest development.

Stainless steel condenser tubing is welded from high quality stainless steel strip on automatic machinery. After fabrication, they are cold drawn to increase strength and improve finish. Stainless steel condenser tubes are guaranteed against preferential corrosion attack at the weld. They can be rolled or welded into the tube sheet with the same equipment and procedures as with copper alloys. At the tube sheet, stainless steel resists oxygen release. There are no galvanic problems.

The trend to stainless steel condenser tubes is growing by leaps and bounds. For more facts, details, and general information, contact the nearest Allegheny Ludlum representative or write: ***Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pa.***

No deterioration after 17 years of operating tests in river water made highly corrosive by coal mine drainage resulted in the selection of Type 304 Allegheny Stainless for the tubes in this condenser unit.

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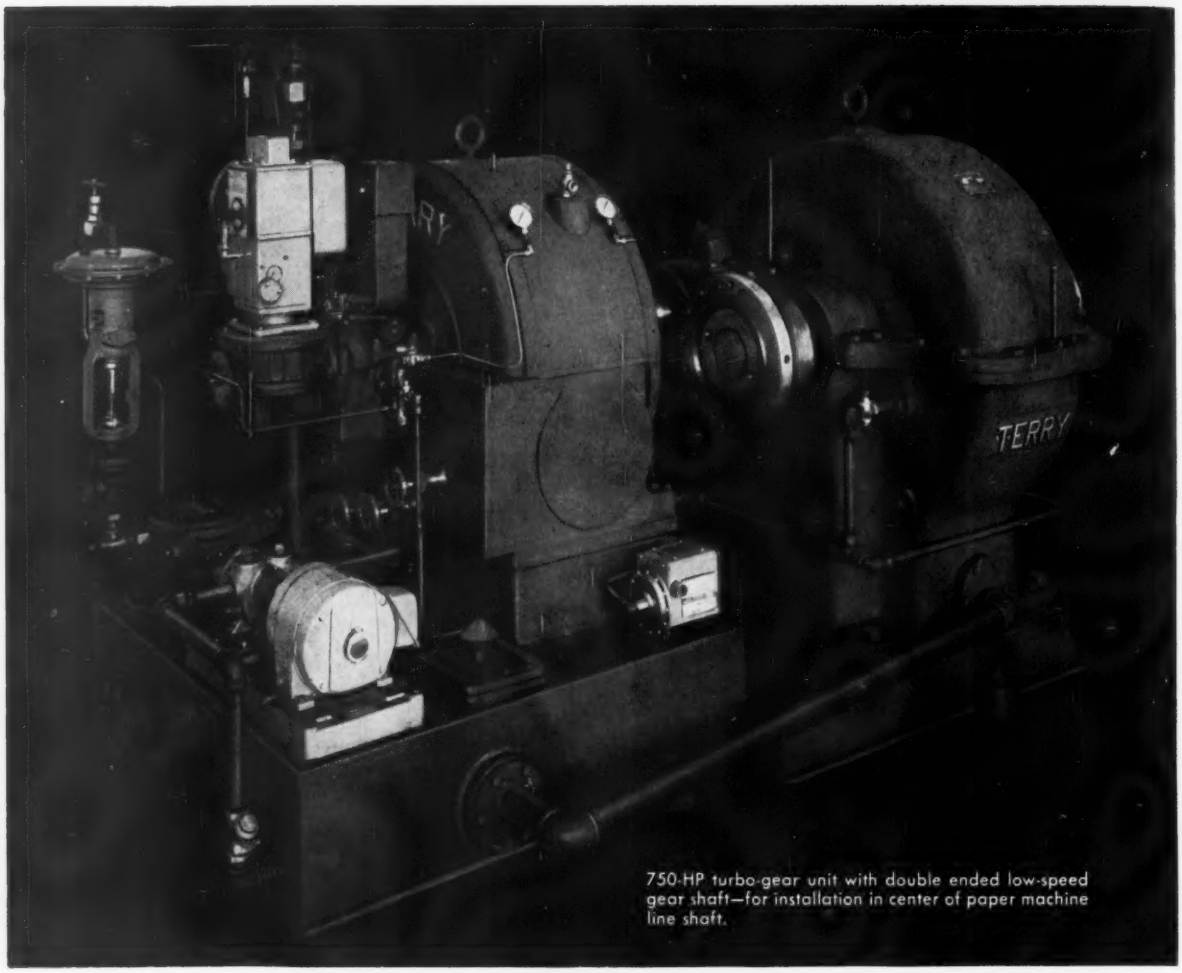


750-HP turbo-gear unit with double ended low-speed gear shaft—for installation in center of paper machine line shaft.

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In service at a large southeastern paper mill, the unit delivers 750 HP at 3350/500 RPM, with steam conditions of 450 lbs., 660°F and 50 lbs. back pressure. Equipped with a variable-speed governor, operated by remote control, the speed of the unit may be varied through a 10:1 range. Other features include forced-feed lubrication to turbine and gear bearings, and automatic shutdown and alarm in case of low oil pressure.

Whatever *your* requirements for low-speed turbine drives, a Terry engineer will be pleased to discuss them with you. Bulletin S-140 covers the full line of Terry turbines; Terry gears are described in bulletin S-130.

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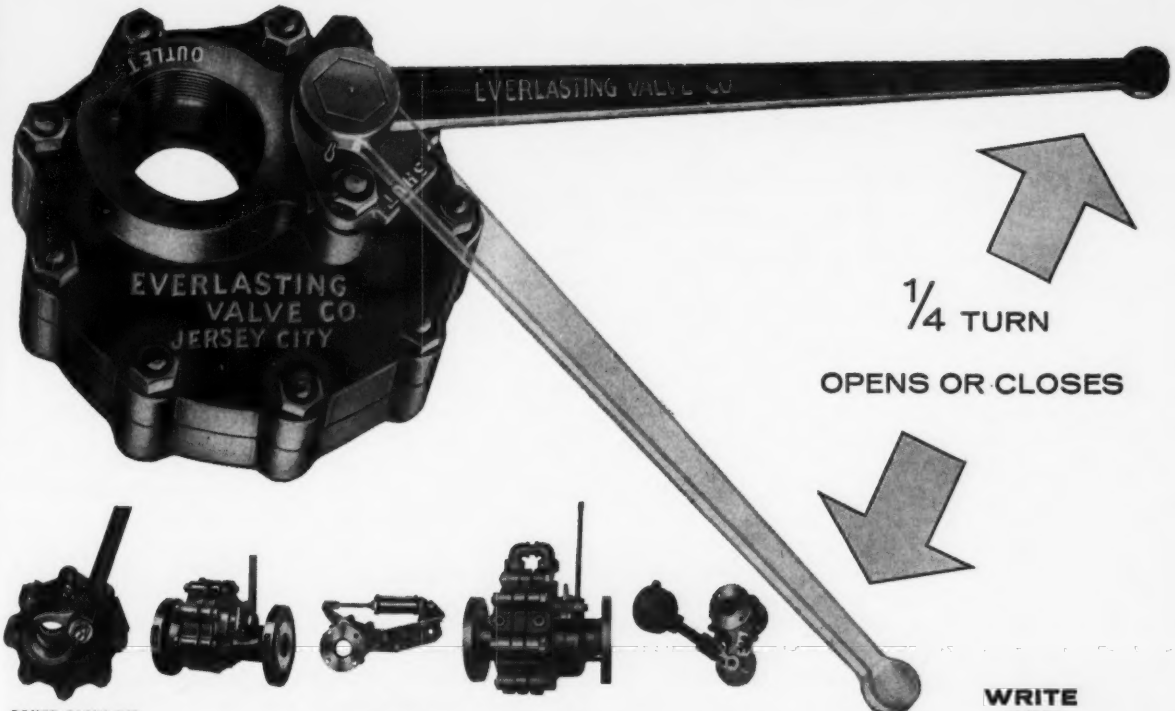


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EV-408

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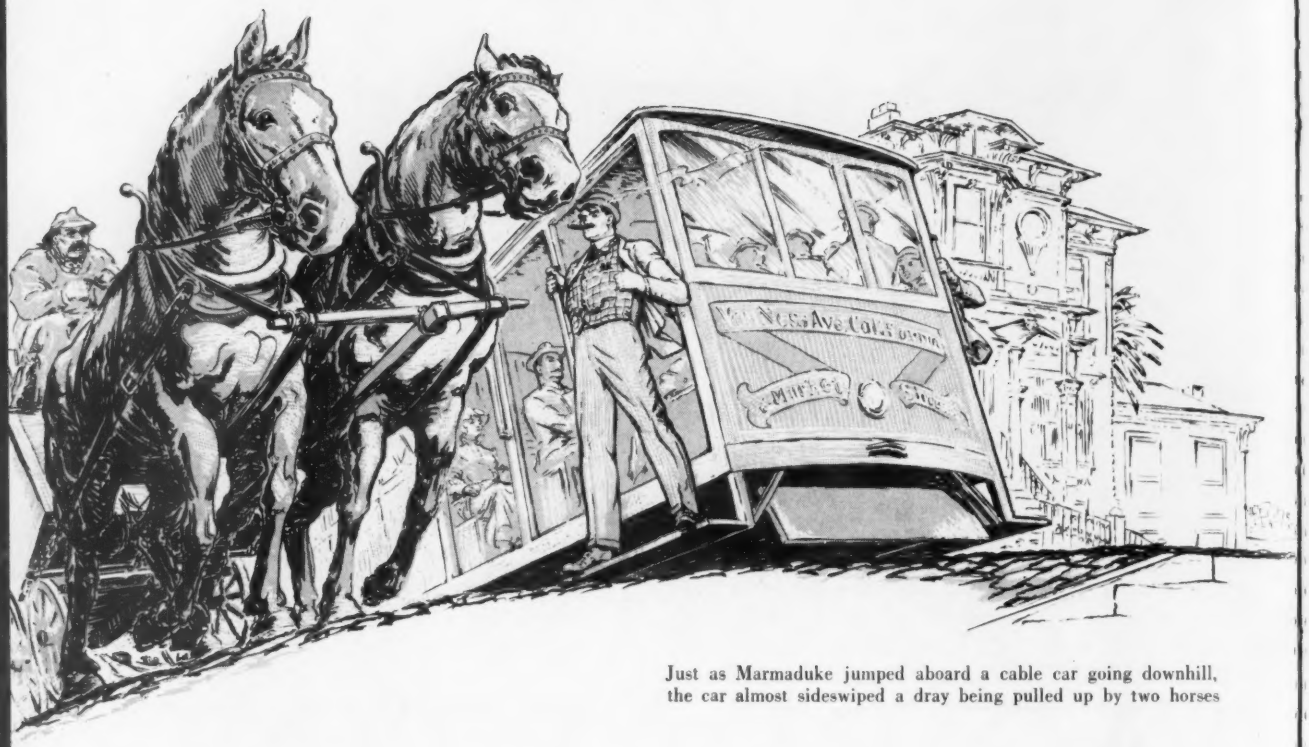


Just as Marmaduke jumped aboard a cable car going downhill, the car almost sideswiped a dray being pulled up by two horses

# Marmy's free-for-all

The Bricklayers' Picnic at Shell Mound Park in Oakland, Calif. did it again—this time on the Fourth of July. It was the afternoon of a glorious Fourth, long ago in the year of 1904. Suddenly, the air was shattered by the urgent clanging of three police patrol wagons and the metallic clatter of hoof beats descending on the park from separate directions. The riot squad was in action and they were in a hurry.

Before you could say "man overboard!" the quiet streets were filled with children and grownups, all running or riding bicycles or horses in the wake of the patrol wagons. But few people were surprised at what was happening—at least not the long-sufferers who lived near the park. It had just been a question of *when* pandemonium would break loose.

Not only bricklayers were involved, but all kinds of guys on the trade level and their gals—mechanics, seamen, printers, plumbers, stationary engineers, fishermen, teamsters—who were out to raise some hell. As always, soon as the empty beer barrels outnumbered the full ones and the music and dancing started, the fighting and real fun began. Then Shell Mound Park once again turned into a glorious sea of flailing fists, screaming girls, flying objects—in short, a general free-for-all.

By the time the first Black Maria noisily arrived, loaded down with the riot squad, two husky youths dashed out of the park. They jumped aboard the trolley just as it left the park gate, destined for the bay and the Oakland-San Francisco ferry, down at the other end of the line.

The two panting young men slumped into a seat, adjusted their disheveled clothing and started wiping the sweat from their tanned faces.

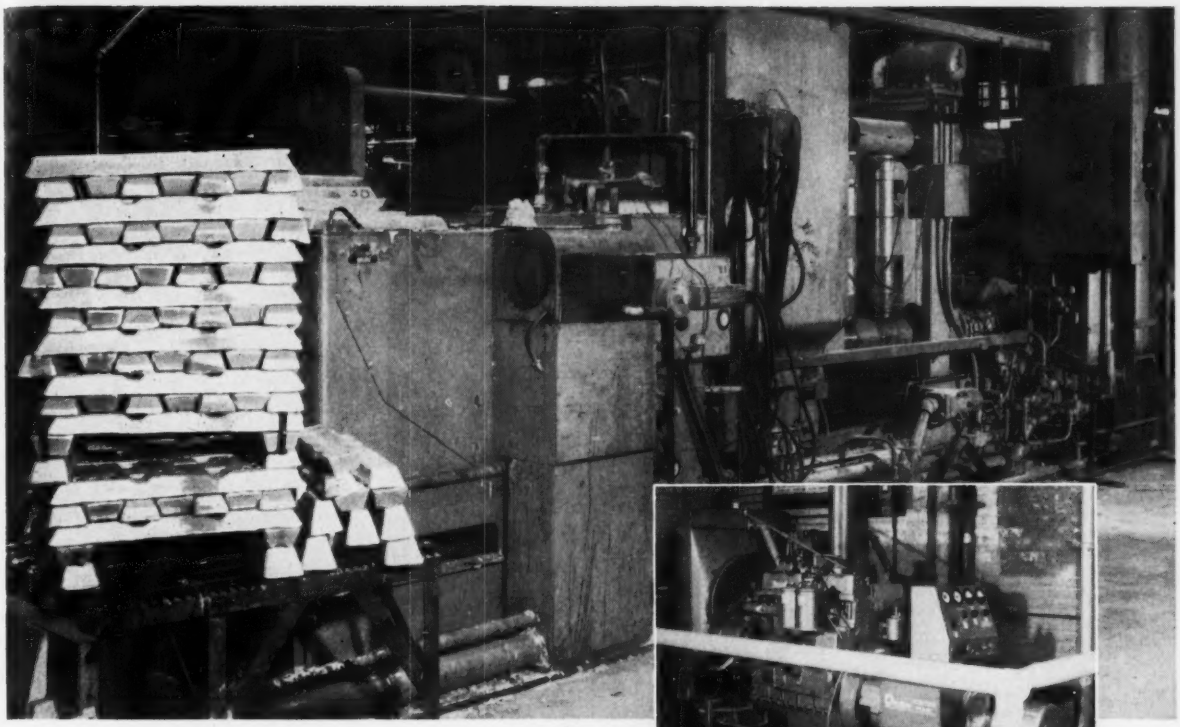
"Well, Marmy, it's like old times again, eh?" puffed the smaller of the two, slapping his six-foot-four buddy on the shoulder. "You sure laid that guy out cold. But I don't blame him for jumping you. You grabbed his girl friend right out of his arms. And she didn't seem to mind, I noticed. Surfaceblow, you're a lucky dog!"

"Her name's Annie McCann," rasped Marmaduke Surfaceblow in his foghorn voice. "Pretty as a South Sea mermaid, isn't she, Charley?" His eyes brightened as a smile slid across his face. "I'll have to see more of that gal, even it it means I have to stay ashore."

"Yeah," laughed Charley, "but it's a good thing we cleared out when we did." Then, catching his breath, he asked, "Who started throwing the beer mugs anyway? The whole gang jumped us but we had plenty of help from those oyster pirates. I'll bet every guy they grab gets a night in the jug. But everybody scattered, I guess."

"It's like old times, all right," answered the young giant, with a faraway look in his eyes, straightening a few dents in his bowler. "I pay off the lumber schooner, run into you on the Embarcadero and first thing I know I'm out here in a free-for-all. Just like the last time I landed in 'Frisco."

After the trolley rattled on for a few blocks, Marmaduke asked suddenly, "Say, Charley, tell me again about that job you're on. I wasn't listening on the ferryboat this



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But this isn't enough. Independent laboratory inspectors pull surprise inspections to double-check our tests and testing methods. They pull a plant off the line, run it, stop it, load it, overload it, check and recheck. Their torture test gives positive proof of Onan's quality. End result: *Onan's exclusive Performance Certification* . . . your assurance of getting every watt of power you pay for.

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## Marmaduke

Begins on page 160

morning, but I got a reason to listen now." Then with a wink he added, "I expect to stay ashore and do some fancy entertaining."

"Yeah, I know," said Charley, "you were too busy ogling those San Francisco gals going to the picnic to pay much attention to me."

Charley told Marmy that the local contracting firm of Warren & Mallery had the job of removing some of San Francisco's sand hills to fill in the low marshy area that's known today as the Marina.

To move the mountains of material, a set of narrow 2-ft-gage tracks had been laid, extending from the biggest sand hill to the Marina. Small side-dump horse-drawn cars were used on level ground around the base of the hill and in the marshy area. But the approach to this hill was another matter—and a ticklish one.

That block-long steep grade was plenty rugged. Empty cars were pulled up by an old mine hoist, belt-driven from a portable steam engine. The engine was a center-crank job with a fly-ball governor. The full cars were braked down the hill.

The hoist used for braking was nothing more than a hand-brake friction clutch. When easing the heavy sand-filled cars down the grade, the hoist operator had to sit on the long lever and hope the brake would hold. Pulling up the empties was the steam engine's job. The horses weren't overworked because the tracks were laid fairly level. But Charley was the hoist operator, and he felt plenty overworked.

"Keeping steam on the portable boiler is easy," volunteered Charley as the two men boarded the ferryboat. "But that engine keeps conking out. A salesman is coming out tomorrow morning; maybe he'll sell the boss a bigger engine. He's gotta do something."

By the time the ferry reached San Francisco across the bay, Marmy had asked his friend Charley a zillion questions. There didn't seem to be a job for the hard-boiled young marine engineer but he wanted to watch the operation anyway.

Next morning Marmy hopped on a cable car on his way to Market Street for breakfast. Just then, the car

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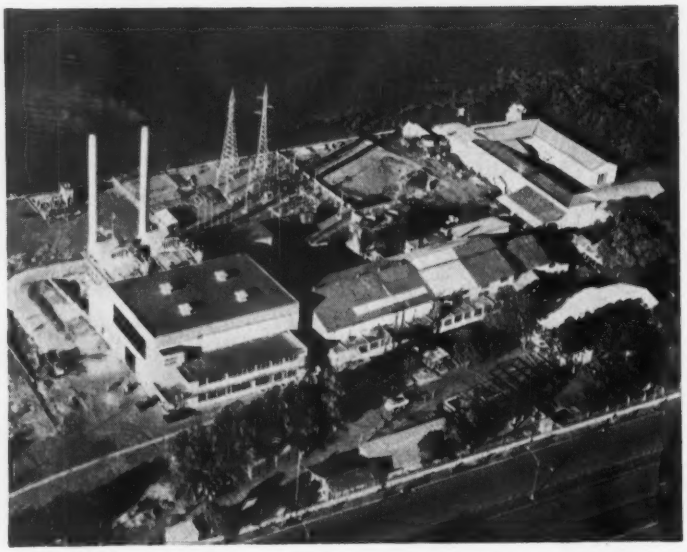

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## Marmaduke

Begins on page 160

almost hit a heavy dray being pulled up the steep hill by two stout horses. The cable tender aboard the car slammed on his brakes just in time. In that instant the odd pieces of that contracting job fell into place in Marmy's brain.

Arriving on the job, he watched steam shovels dumping sand into the cars. Then he saw Charley sitting on the long lever, lowering a string of sand-filled cars down the steep hill. Marmy watched the little steam engine chugging away as it pulled up the empties on the other track. It sounded as if each chug would be its last.

Before long the boss arrived—just as two men approached. "We sized up this job yesterday, Mr Warren," said one of them. "What you need is our new twin-cylinder portable engine. That baby won't stall and she won't break down. Will she, Herb?" he asked his companion for reassurance in the matter.

"Look fellas," put in the contractor, "I got about two years' work to fill in the Marina and I don't want delays. Can't afford them—I bid low to get this job. How much you asking for this new engine?"

"Only $6750, delivered here on the job," answered the salesman, sticking on the added information in hopes of making the price seem unimportant.

"Good God, I'll have to move more than sand to pay for that machine," whistled the contractor, frowning.

"BILGEWATER on spending that kind of dough," roared a foghorn voice from behind the group. "I've been looking at that putt-putt knocking itself out and I got the *right* answer. For 500 bucks I'll tell you how to beef up this circus. And you can soup it up for less than you'd pay for a new piston."

That statement was almost like putting in a riot call.

"You're crazy," suddenly exploded the salesman, working up a full head of steam as he sized up the brash young speaker. "Look at that old piece of scrap iron," he yelled, pointing towards the engine. "You trying to tell us it's good for anything but the junk heap?"

"Wait a minute," cut in the contractor. "Exactly what you got in

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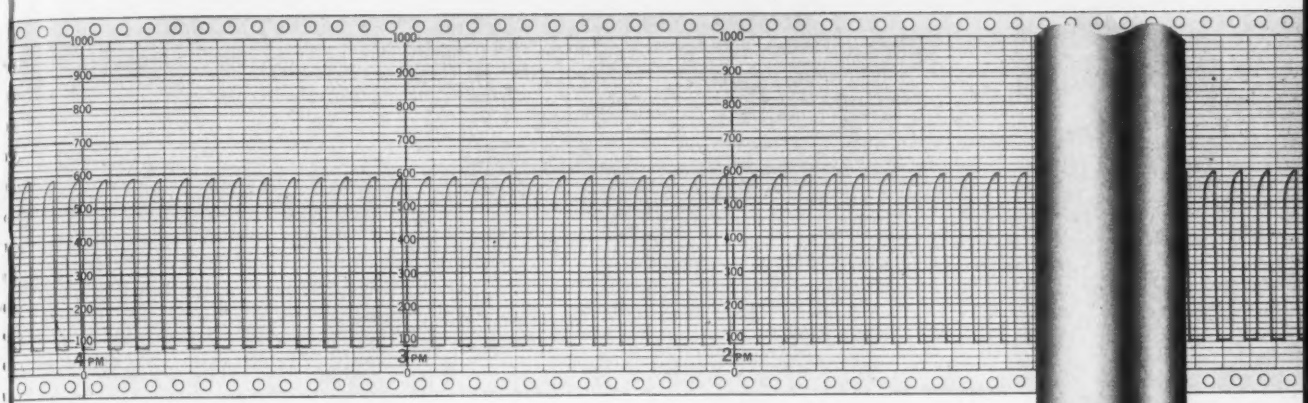
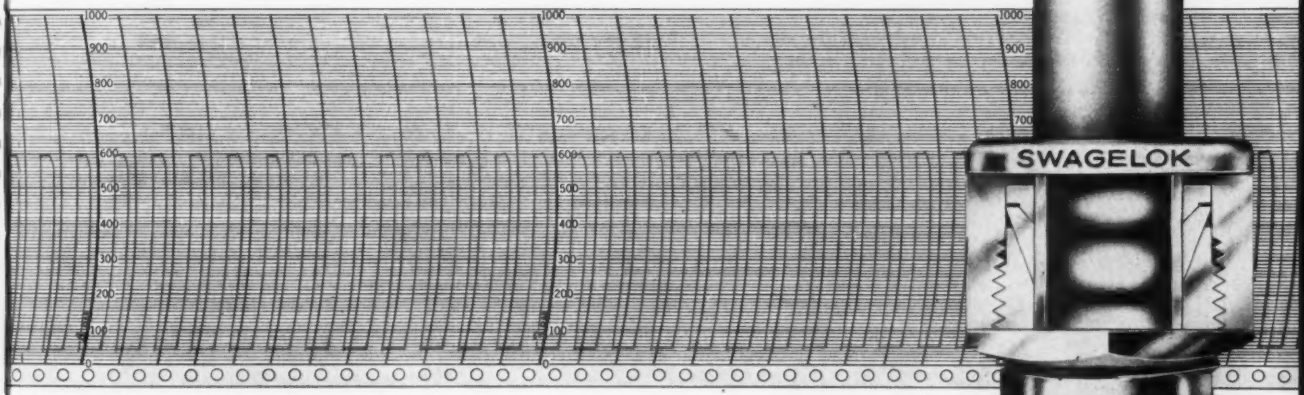
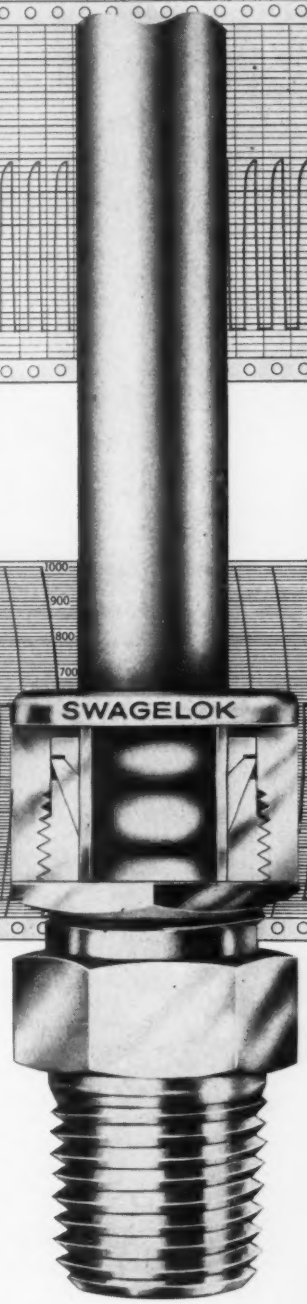



**TEMPERATURE VS TIME RECORDING:** The peak temperatures 580° to 600° F. occurred during the maximum pressure period. 750° F. steam was used but inability to keep insulation intact due to severity of the thermal shocks limited the maximum temperature. The minimum temperatures occurred during the cold water flush.




**PRESSURE VS TIME RECORDING:** The maximum pressures on the chart were produced by 600 psi superheated steam at a source temperature of 750° F. The minimum pressures were the result of opening the system dump valve and flushing with 50° F., 500 psi cold water.

The tests recorded on the above charts were conducted on one inch carbon steel hydraulic tubing (ASTM-A-179) using carbon steel SWAGELOK Fittings. Thirteen to sixteen SWAGELOK Tube Fitting connections were in the systems and 1200 severe thermal shocks were applied on each of two different tubing configurations without leaks or failure. The conditions used in this test were considered casualty or mal-operation conditions and are not recommended practice for any system design.

These tests prove that for steam system instrumentation and steam tracing service, SWAGELOK Tube Fittings solve your problem.

Swagelok® TUBE FITTINGS

Crawford Fitting Company • 884 East 140th Street • Cleveland 10, Ohio • Crawford Fittings (Canada) Ltd., Niagara Falls, Ontario, Canada

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*Adjustable* **SPROCKET RIM**
*with Chain Guide*
Changes that Danger Zone to a
**SAFETY ZONE**

—saves you money
ON EVERY VALVE

Every minute saved is money in your pocket. Cut out the waste of time, labor, floor space due to hard-to-reach valves. At the same time, convert Danger Zones to Safety Zones. Equip every overhead valve in your plant with Babbitt Adjustable Sprocket Rims with Chain Guides for day to day economy.

- They simplify pipe layout.
- They fit any size valve wheel.
- They are easy to install and operate.
- They operate any valve from the floor.
- They save time and money.
- The first cost is the only cost (no maintenance).
- They are packed completely assembled (one to a carton), with easy-to-follow instructions.
- A hot-galvanized rust proof chain is available for all sizes.

Babbitt Adjustable Sprocket Rims with Chain Guide are carried in stock by most mill supply houses. Just phone your mill supply salesman, or contact us

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2 Babbitt Square, New Bedford, Mass., U.S.A.
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**With Alkaserts®...**
**CONDENSER TUBES LAST LONGER!**

■ Low cost ALKASERTS lick the problem of inlet end erosion and impingement. These polyethylene inserts *push-fit easily and securely* into inlet ends of new or old condenser tubes. No adhesive is needed to install. ALKASERTS are flexible, dimensionally stable at 70°C. (158°F.).

■ For new tubes, use "Standard" ALKASERTS . . . streamlined to prevent water flow restriction. Snug fit—no danger of water seepage between tube and ALKASERT.

■ To get maximum life from old tubes, use "Expanded" ALKASERTS . . . made in graduated sizes to match wear pattern found in normal installations.

■ For the complete story on ALKASERTS, write for new Bulletin 600.

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***More equipment manufacturers choose Fast's Couplings than any other gear-type coupling***

Leaving other claims aside, the thing that counts in couplings is customer confidence—and industrial equipment manufacturers have made Fast's their overwhelming choice. The Fast's line is more diversified, too—in a complete range of sizes and types for shafts, from ½" to 32" and larger.

Every Fast's Coupling brings you superb engineering only the original gear-type coupling can deliver. Smooth-running units that are designed to outlast the machines they connect. Rapid service from experienced field engineers backed by outstanding stock facilities. Write today for full details on couplings to suit your needs to: KOPPERS COMPANY, INC., Fast's Coupling Dept., 1106 Scott St., Baltimore 3, Maryland.

KOPPERS®
**FAST'S COUPLINGS**
Engineered Products Sold with Service


## Marmaduke

Begins on page 160

mind, young fellow? If I can save $6000, I'm interested."

"I'm Marmaduke Surfaceblow and I just signed off the steam schooner *Sea Gypsy* as Third Assistant Engineer. Charley Gillespi here was shipmates with me on the *U.S.S. Oregon* last year. I'm not a landlubber but I'm willing to help out."

"Put 'er there, Mr Marmaduke," said the contractor good-naturedly, shaking hands. "Now, what's your proposition?"

"Very simple," answered Marmaduke. "I'll keep this outfit running without that new gold-plated engine. You fork over 500 clams—but only if you like my idea."

"That's a deal," assured the contractor, shaking hands again to clinch the agreement.

"OK," shot back the young mariner, "I've been looking at your hoist drum. It's wide enough to handle four times the cable you use. Send it to a machine shop and have a collar bolted in the middle to divide it into two drums. That can be done in a few hours and shouldn't cost more than $50."

"Keep talking," smiled the contractor. "I'm still aboard."

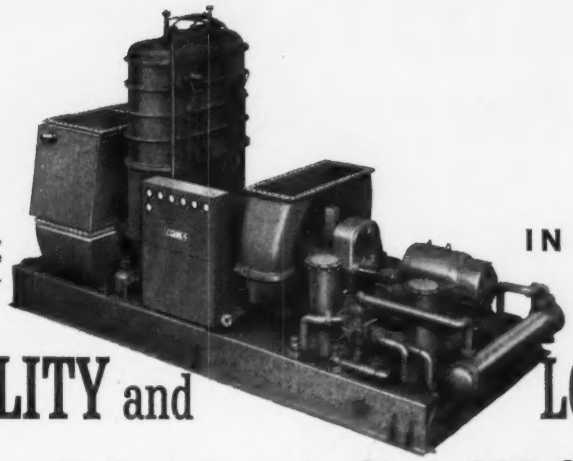
"I notice you brake your loaded cars going downhill and pull up empties with the steam engine. Why don't you let the full cars going down one track pull up your empties on the other? Every loaded car going down is a gravity-powered engine that doesn't need a bit of fuel."

"And just how do you propose doing that?" questioned the contractor.

"Just wind one length of cable on one half of the drum clockwise, another length on the second half counterclockwise," answered Marmaduke. "Then a string of loaded cars going down will pull up a string of empties each time. That's what I call my free-for-all scheme. Gravity energy not only costs nothing, but you'll have much less braking to do and Charley here won't be a nervous wreck at the end of each day."

"Sounds great!" shouted the contractor jubilantly. "I'll try it. And if it works, you've made yourself $500 and me a year's profit."

Next morning when Marmy showed up at the sand hill the full cars were



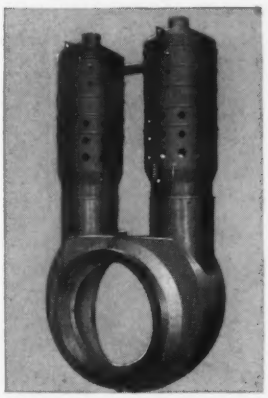
Clark Model 305-S, single shaft gas turbine rated at 9000 hp.

IN GAS TURBINES YOU LOOK FOR

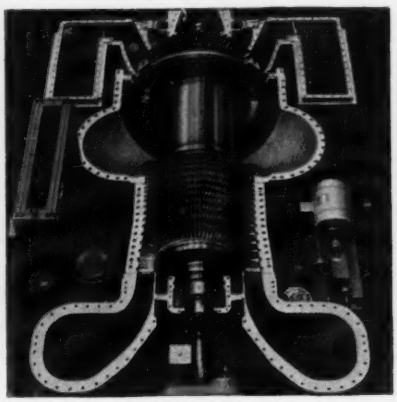
# RELIABILITY and LOW FIRST COST

## Here's why you'll find them in Clark 305 Series Gas Turbines

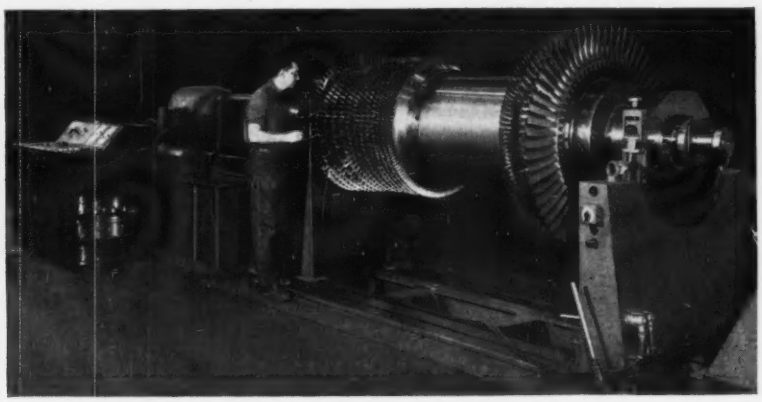
- **Heavy Duty Industrial Design**—Simple, open cycle machines, built for continuous, full load operation . . . ideal drivers for compressors, generators and pumps.
- **Single Shaft Construction**—Provides high rotating inertia and minimum speed variations under transient load conditions. Two-Shaft units available for applications requiring wider operating flexibility.
- **Design Simplicity**—Integral compressor-turbine rotor is supported by two readily accessible journal bearings. Entire unit including combustion system is contained in common casing structure.
- **1400°F Operating Temperatures**—Insure long life of hot parts plus substantial margin of safety.
- **Air Cooled**—Pressurized air cools high temperature components . . . air envelopes minimize heat loss and operating temperatures wherever possible.
- **Vertical Combustion Chamber**—Prevents direct flame impingement on turbine blading . . . assures more uniform heat distribution.
- **Horizontally Split Casing**—Upper half can be removed in one piece to remove rotor . . . inspections quickly made using light lifting equipment.
- **Renewable Labyrinth Seals**—Of honeycomb construction . . . minimize leakage at all close clearance points on turbine shaft.
- **Proved Reliability**—Materials of construction and important components such as turbine blade root design, turbine discs, journal bearings and axial compressor based on broad Clark experience in building heavy duty gas turbines.



Unitized combustion chamber with two parallel burners, each enclosed in a liner of high temperature nickel chrome alloy.



Single rotor is supported by two journal bearings for greatest simplicity. Horizontally split housing provides easy accessibility.



Rotor is statically and dynamically balanced for optimum performance. Turbine blades are of high temperature forged steel. Air streams cool turbine blade roots and both sides of discs.

You are invited to get full details on how Clark 305 Gas Turbines can bring you lower first cost, reduced floor space and installation costs, plus dependable, economical performance. Contact your nearest Clark representative or write for Bulletin 186.

**CLARK BROS. CO., OLEAN, N. Y.**

CLARK® DRESSER INDUSTRIES INC.
OIL • GAS • CHEMICAL
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For more facts circle 299 on Reader Service card, p 121

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**3. New Fast-Action, Cam-Type Workholder** sets to size by quick turn of collar. Set screw holds work centered for perfect threads every time . . . adjustable for drip threads.

**Your Supply House has them! Order your new RIDGID No. 141 Threader today!**

RIDGID

The Ridge Tool Company, Elyria, Ohio, U.S.A.

**For more facts circle 300 on Reader Service card, p 121**


## Marmaduke

pulling up the empties, just as he suggested. The contractor and some mechanics from the machine shop had made the change on the drum and rewound the cable. They were watching the operation with great interest.

When the contractor saw Marmaduke he slapped him on the back and slipped an envelope into his hand. "I knew your scheme would work soon as you explained it," he laughed, "so I had my bookkeeper make out this check last night."

Just then the steam-engine salesman drove up in a carriage accompanied by a lovely young lady.

"This young man was right," volunteered the contractor as soon as he saw the salesman. "Just look at those filled cars highball those empties up that steep grade. Almost like perpetual motion and it's free power."

"Marmy," called the young lady from the carriage.

"Annie McCann," greeted Marmaduke, gallantly sweeping his bowler and helping her out of the carriage.

"You know my daughter?" asked the salesman, very much surprised.

"She's the reason I'm staying ashore for a while before going back to sea," answered Marmy.

After glancing at the marine engineer and then back at his daughter, the salesman scratched his head and said, "Well, you beat me out of a rich sale but you just got yourself a job. I bought the engine works last week and I need a good salesman who can size up a job and use his head. Any guy who thinks as straight as you do and can talk turkey to a big contractor like Mr Warren here is sure to make money for both of us. Besides," he added, "I got to attend to business at the shop."

"That's the spirit, Mr McCann," piped up the contractor. "This young fellow has got a head on his hefty shoulders. And your Annie is a very pretty girl. How about all of you coming out to the Construction Workers' Picnic at Shell Mound Park in Oakland next Sunday. We'll have about 400 people with plenty of free beer and dancing. I guarantee a good time, and it's free-for-all."

Marmy and Annie glanced at each other, then bust out laughing.—*SME*

**continued**

Begins on page 160

## Marmy's mail

LIKES NEW LOOK

Enjoyed reading *Marmy cools some hotheads.* His style is new and I like the story told in the third person. This yarn is a dandy besides.

S FISHER, *New York City*

ENGINEER'S ENGINEER

No doubt about it—Marmy is an engineer's engineer. Enjoyed reading *Marmy's bowed shaft* in January POWER. Many younger engineers should cash in on that story. Some day they'll remember it and it will save them a lot of trouble. You can take my word that he is 100% correct on his theory of bowed shafts.

C BACHMANN, *Jamaica, N.Y.*

STORY UNLIKELY?

The July 1960 yarn, *Marmy's playful diesel,* is hard to believe. Omitting the fact that it is very unlikely that there would be no qualified operator in charge in a hospital of that size, please explain the following:

The screen door on the emergency generator would be 80 × 30 in., or 2400 sq in. If the diesel created a partial vacuum of 10-in. Hg, that would be about 5 psi, creating a total pressure of 5 × 2400 or 12,000 lb on the door. Besides, local regulations are very keen on air intakes, also proving my point.

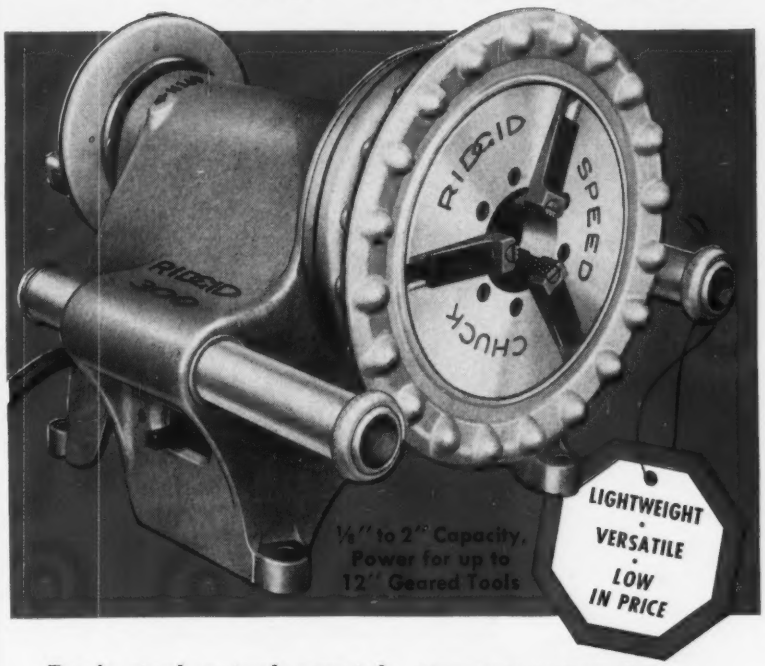
I hope Marmy harbors no ill feeling because of this letter. I hasten to add that your magazine is doing a first-rate job of distributing technical information in a pleasant form.

W H KIEWIET,
*Bloemfontein, S. Africa*

EDITOR'S NOTE: *When we showed Marmy this letter, he carefully anchored his bottle of Sandpaper Gin and roared* BILGEWATER *on screen doors. I said the* screen on the door. *It was a wooden door, with a 24 × 24-in. opening covered with a heavy screen. This story is true, happened exactly as I told it. For a slight sum of Chinese yen, I'll be happy to send Mr Kiewiet a report on the problem from the insurance company files."*

**Easy-to-Move...Time-Saving Power for Your Shop or on the Job... New**

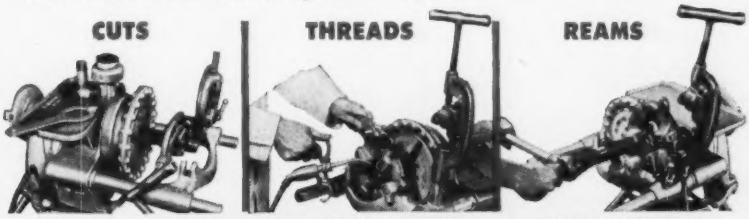
**RIDGID® 300 Power Drive**




Bench, stand or truck mounted, this compact RIDGID 300 Power Drive quickly pays for itself in time and labor savings. Speed chuck closes and releases by hand . . . holds tight forward or reverse. Cam-action rear workholder holds even long lengths straight for perfect threads and cuts every time.

**Converts to Low-Cost Threading Machine**

Add the RIDGID No. 310 Carriage, No. 360 Cutter and a RIDGID Quick-Opening Machine Die Head, and you're ready to cut, thread and ream. With a No. 19 Nipple Chuck you even cut and thread close nipples with threading machine speed and ease.

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**Call your Distributor today. For your convenience, he maintains a complete stock of RIDGID Work-Saver Pipe Tools and parts!**

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The Ridge Tool Company, Elyria, Ohio, U.S.A.

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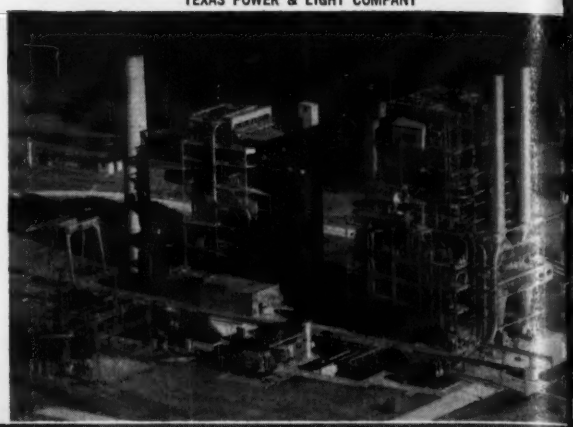
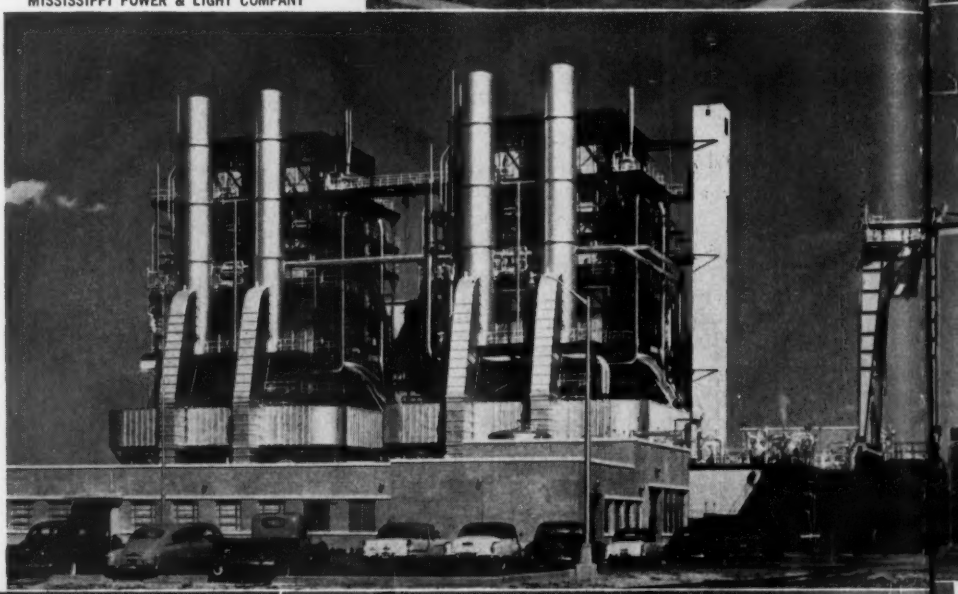
TEXAS POWER & LIGHT COMPANY



MISSISSIPPI POWER & LIGHT COMPANY



ARKANSAS POWER & LIGHT COMPANY

MINNESOTA POWER & LIGHT COMPANY

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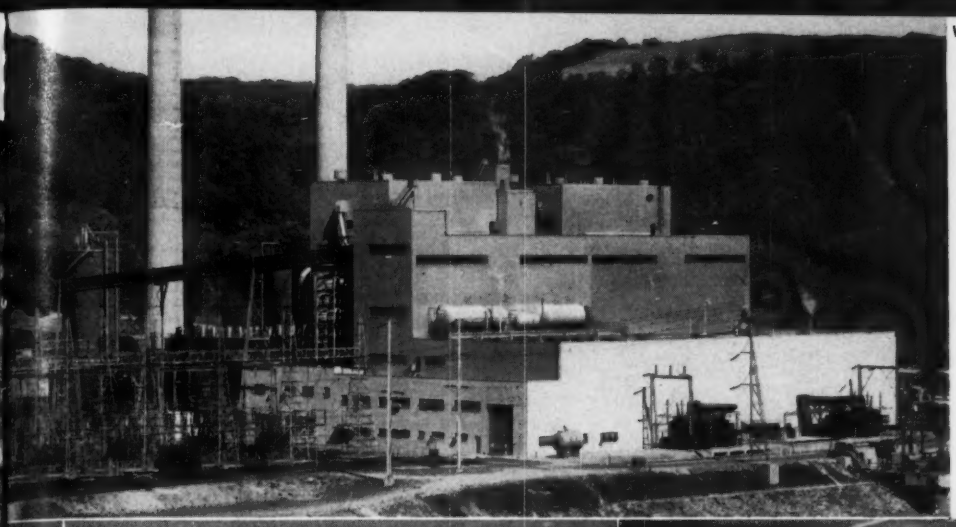

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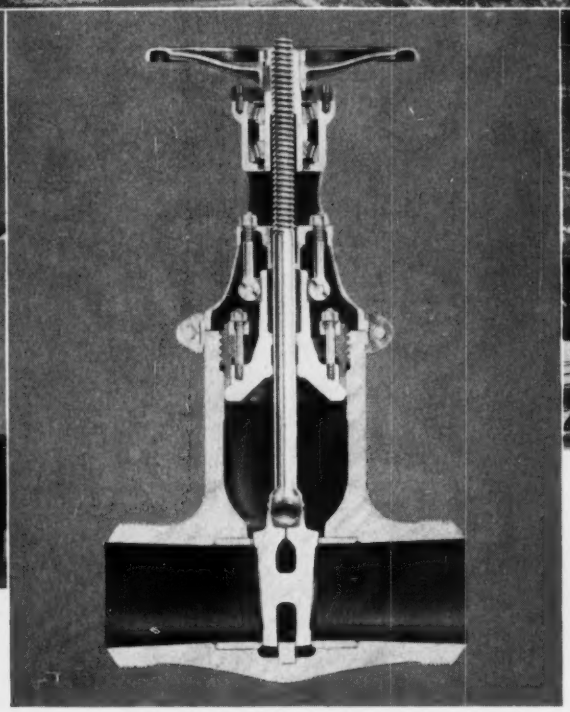

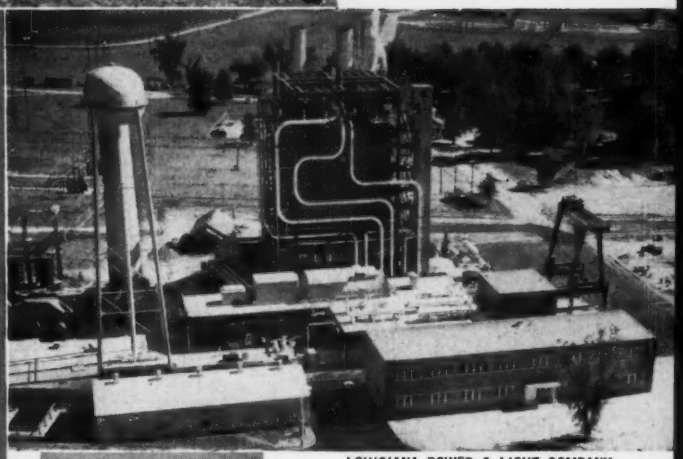

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## Power plants, coast to coast, rely on

# WALWORTH

## Pressure - Seal cast steel valves

Power is going up! 39,153 Mw of new steam power are on drawing boards now. ■ Who will make the valves to control this torrent of steam? Walworth, of course, with Pressure-Seal Valves...also bronze, iron, steel valves...all types and sizes...for every steam plant application.

■ Wherever you must control fluid flow—remember Walworth. See your distributor. Walworth, 750 Third Avenue, New York 17, N. Y.

WALWORTH SUBSIDIARIES: Alloy Steel Products Co. ■ Conoflow Corp ■ Grove Valve & Regulator Co. ■ M&H Valve & Fittings Co. ■ Southwest Fabricating & Welding Co., Inc.

# Powerscope . . . A selective look at

## Municipal hydro plant starts

Sacramento Municipal Utility District, a distributor of electric energy for the past 14 years, now has its own hydro plant. The first 66.5-mw generator at its Jaybird Powerhouse started running on May 1st. A second unit will go on the line in about one year. The plant is designed for 238-mw capacity and may rise to 500 mw in the distant future. The District's dispatching office in Sacramento, 60 miles away, supervises the unit through microwave and carrier current control. Plant water flows through a 5-mile tunnel from a junction reservoir on Silver Creek. The water drops 1540 ft, making Jaybird one of the few plants in California with this high a head. (*McGraw-Hill World News*)

## New gas-turbine drive

**AiResearch Division of The Garrett Corporation has delivered to the U.S. Navy a 150-hp gas turbine driving a 33-in. fan. Fan supplies 60,000 cfm of air through a diffuser and 90-degree bend. The unit will be used to give complete design parameters for air-handling systems to supply future operational ground-effect machine (GEM) vehicles. AiResearch has been working on this program for the past two years. Current work includes studies of systems for GEM's to 100-ft diameter. The turbine's high-performance fan has a system of accurately controlled variable blades and stators.**

## Crystal-balling power

The 29th Semiannual Electric Power Survey of the Edison Electric Institute predicts that the U.S. utility industry will produce 819-billion kwhr in 1961—excluding Alaska and Hawaii. This will be a 7% increase over the 765 billion produced in '60. The 1964 production is predicted at over 1-trillion kwhr. Capability will be 188-million kw by December 31, 1961, a 7.4% rise above 1960's 175-million kw. By 1964 this should be 221-million kw. December 1961 peak load is predicted at 145-million kw, 8.9% above 1960's 133 million; by 1964 this may be 177-million kw. So reserve capability in 1961 reaches 29.6% above peak—by 1964 this is expected to drop to 24.4%.

## Guinea pigs test pollution effects

**The U.S. Public Health Service, Los Angeles County Air Pollution Control District and the University of Southern California have a research project under way to find the effects of air pollution on laboratory animals. Test animals—mice, guinea pigs and rabbits—will be located at varying distances from heavily traveled highways at four sites. A control group will live in purified air, in a laboratory. Researchers hope to find effects in the animals in a short time—effects that may take decades to show in humans. The initial $152,000 contract will cover establishment, operation and maintenance of the stations until June 15, 1961.**

## New carbon isotope

The Atomic Weapons Research Establishment in Aldermaston, England has discovered a new carbon isotope with mass 16. The isotope was produced by bombarding carbon-14 with a beam of 6-mev tritons. Mass of the new isotope, determined by spectrograph, is 16.014702 atomic mass units. Carbon-16 has a half life of only 0.74 sec. Natural carbon consists of 98.9% carbon-12 and 1.1% carbon-13. Carbon-14 is formed in the atmosphere by bombarding action of cosmic rays; it emits beta rays and has a half life of 5600 years. Carbon-15 is produced in the laboratory; its half life lasts only 2.25 sec.

## Gas-line gas-turbine drive

**The Tennessee Gas Pipeline Company is installing a Solar Aircraft Co centrifugal-compressor unit in its Leeville, La. station. The driving gas turbine delivers 1100 hp and can run the compressor delivery up to 1000 cfm at 1500 psig. In the past, this range was usually supplied by reciprocating compressors. The centrifugal unit can run at up to 30,000 rpm, allowing direct coupling with the gas turbine. Compressor wheels are interchangeable, so alterations can be made in the field to handle new flow conditions without switching complete units.**

## "Spark pump" offers possibilities

Lead zirconate-titanate (PZT) is piezoelectric—it generates electric energy when put under pressure. Predicted uses: supplying energy to electrostatic air filters, spark ignition for oil and gas furnaces and clothes dryers, speedometers and weighing devices. Clinton Engines Corporation use PZT in a "spark pump" for spark ignition in a new line of small engines. Although it's not as large as a man's

# this month's power-field happenings

B G A SKROTZKI, Associate Editor

fist, the "pump" replaces conventional magneto, points, coil and condenser. It delivers constant full voltage at all engine speeds and at startup. Tests show a five-fold increase in engine spark-plug life.

## Desalted water under $1 per 1000

**Vacuum-freezing process created by Alexander Zarchin of Israel is used by Fairbanks Whitney in equipment designed for commercial production of desalted water. Operating cost is predicted at less than $1 per 1000 gal. Entering salt water is cooled to nearly freezing temperature and sprayed into an evaporation space under vacuum. Part of the water vaporizes, another part freezes to ice, remainder becomes a more-concentrated brine. The vapor, ice and brine are separately withdrawn from the evaporation space. Ice is washed free of the brine and mixed with the vapor to condense the vapor and melt the ice to form fresh water. Both the fresh water and brine are used in heat exchangers to cool incoming salt water.**

## British merger

General Electric Co, Ltd and Richardsons Westgarth and Co, Ltd are pooling design, development, sales and manufacturing resources. Manufacture of all equipment including steam turbines, alternators, blowers, compressors, exhausters will be shared and initially based on General Electric designs. Richardsons Westgarth will concentrate on designing industrial power plants to supplement existing General Electric designs and increase the range offered. They will continue to make condensing and feed-heating plants, rotary water strainers, evaporators and shell boilers to their own design and watertube boilers to Foster-Wheeler designs. (*McGraw-Hill World News*)

## Turnkey peaking gas turbine

The City of Houma, La. has bought a 12-mw Econo-Pac gas-turbine power plant from Westinghouse Electric Corporation. The self-contained automatically controlled unit was sold on a "turnkey" basis. Plant will be semiportable with prefabricated construction. It will do summer peaking for about 1000 hr annually, could run continuously if needed. Houma will fuel the plant from its own gas wells, but an automatic transfer to distillate oil is provided. The plant needs a flat concrete-slab foundation about 3-ft thick; it can be running less than two weeks after delivery to the site. Turbine will work with a system supplying energy from ten diesel engines with total installed capacity of 19,645 kw, including three 3750-kw engines installed in 1959. Barnard and Burke, Inc are preparing long-range plans for transmission- and distribution-system expansion with new substations, feeders, transformers and capacitors.

## Electronic heart control

**General Electric Company has announced an electronic device called the Pacemaker that can monitor and regulate body functions and control the heart beat. Several hundred people a year develop a kind of heart disease that disturbs control impulses the brain sends to the heart. Surgically inserted next to the heart, the Pacemaker takes over this function from the brain and regulates heart beat by electronic impulse. The patient carries the controls in a pocket, attaches them to a belt to use and places the antenna coil over his heart, where the implant was made. Battery will last up to five years; it can be replaced by minor surgery if necessary.**

## Brightest thing in the world

The U.S. Army Corps of Engineers now has the brightest light in the world, equal to 200 modern 100-w bulbs. The 3-kw light source was built by Duro-Test Corporation under contract with the U.S. Army Engineer Research and Development laboratories. The lamp has a luminous source about seven mm in diameter, two to three times as bright as the sun. The radiating xenon plasma works at 15,000 F and is held by a fused-quartz envelope under a pressure of 140 psig. The new lamp probably will replace carbon-arc lamps; it is clean, needs little maintenance, has no open flame with carbon fumes, provides perfect daylight color. Life-span: up to about 1000 hr.

## English Electric incorporates

**The English Electric Corporation has been incorporated in the State of Delaware as a wholly owned subsidiary of the English Electric Company Limited of London, England. The new corporation consolidates U.S. activities of the English Electric Export and Trading Company, Marconi's Wireless Telegraph Company, Marconi Instruments and the English Electric Valve Company—all have been represented here for ten years or more. E S Dean is president of the corporation.**

# TRIM COST

## OF WELDING STAINLESS

Remember: only Airco makes everything for Aircomatic®, Heliwelding, and stick electrode welding of stainless. Don't decide until you let Airco compare all 3 welding processes for your application.

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circle 303 on Reader Service card, p 121



## MOVING?

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WE'LL DO THE REST!

**POWER**
**330 West 42nd Street**
**New York 36, New York**


## Powerscope

Begins on page 172

### Fuel-cell research on upswing

(*McGraw-Hill World News*) Dr Ernest Yeager, lecturing at the University of Toledo, believes fuel-cell generation of electric power improved through basic science research. Western Reserve University, where Dr Yeager is professor of chemistry, recently developed a cell for the Navy, that uses metallic sodium as fuel. Cell generates about 2½ kw per cu ft of structure at an estimated cost of 20¢ a kwhr.

Esso Research and Engineering Company, Linden, N. J., has developed a cell using ethane gas as fuel. Object: find a convenient way of producing electric power from oxidation of combustible substances producing a minimum amount of heat (see POWER, Feb 1961, p 79).

Harvard Graduate School of Business Administration sees even bigger future for fuel cells. In a recent analysis they predict ultimate development of cells that will last over 100,000 hr.

Ionics, Inc is among some 50 U. S. companies engaged in fuel-cell research (POWER, Nov 1960, pp 59-63). Ionics uses a combination of hydrogen and bromine to fuel a special cell where weight and convenience are important, cost is not a major factor.

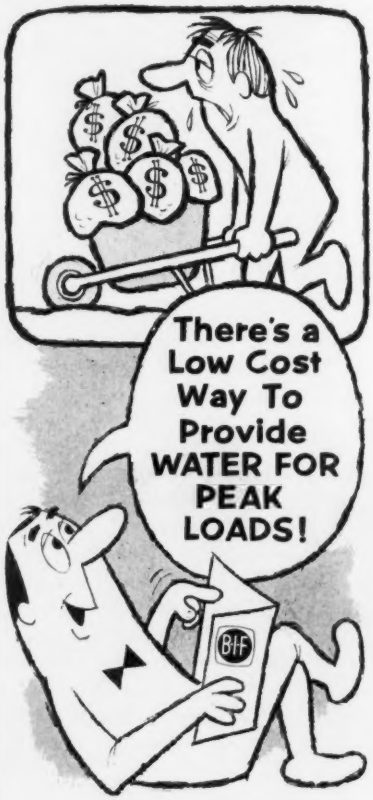
### Rivers to reverse flow

**Moscow** (*McGraw-Hill World News*) Premier Khrushchev, in a speech to the Agricultural Plenum, has approved a scheme to partially reverse flow of Pechora and Vychegda Rivers and thereby raise the water level of the Volga River and Caspian Sea. Pechora and Vychegda now flow into Arctic Ocean. Their waters will be diverted into Kama River and then into the Volga. Large reservoirs will be built on the rivers and linked by canals. Plan is to divert 40 cu km of water annually.

Power stations to be built on Kama and Volga would then produce electricity at half the cost of those already existing on the Volga. Power-generation potential on these two rivers might increase by 2.3 mw.

continued


B·I·F POSITIVE CONTROL OF MATERIALS FLOW




Delaying needed water filtration expansion because of high costs? Want to know how to meet peak load demands at a fraction of the cost normally required? B-I-F's new, low cost filtration system, built around performance-proved Vacuum Diatomite Filters, provides building-block flexibility . . . allows you to expand system . . . economically . . . as demands increase.

## Free Facts

From its wide line of compatible components, B-I-F will provide a coordinated system to meet your specific peak load requirement. If you want water purer than sand filters can provide, at a low cost that will amaze you, request free facts today!

B·I·F **Industries**

BUILDERS-PROVIDENCE • PROPORTIONEERS • OMEGA
354 HARRIS AVENUE, PROVIDENCE 1, RHODE ISLAND

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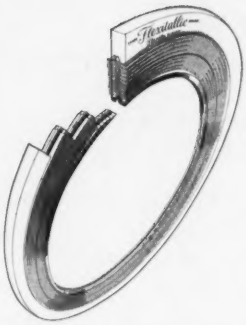


Flexitallic®
SPIRAL-WOUND GASKETS

# The nuclear navy

## ...where gaskets must not fail

For critical sealing applications in the Nuclear Navy, engineers depend on Flexitallic Gaskets.

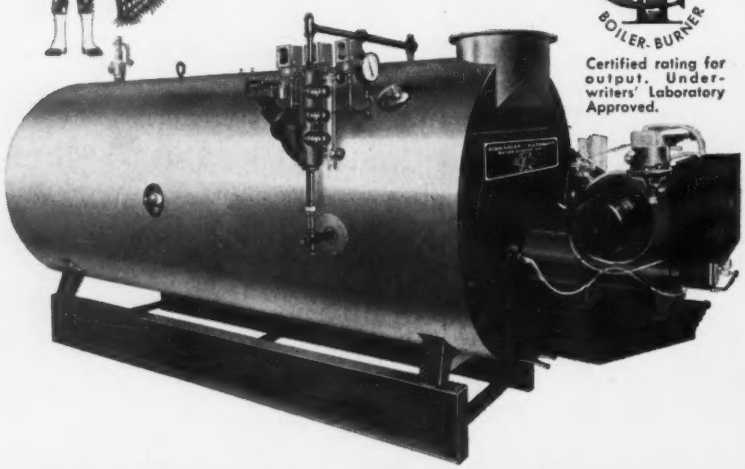
In Flexitallic Spiral-Wound Gasket construction, type of metal, type of filler, relationship of metal to filler — all are variables in the hands of the Flexitallic engineer.

Every Flexitallic Gasket is designed for the specific job it has to do, based on the flange geometry, temperature and pressure of the confined fluid, bolt load, corrosion, vibration, unusual joint stress. Style CG Gasket, illustrated, has Flexite Finish to inhibit corrosion.

Give us the facts about your most serious sealing requirement — in chemical processing, petroleum, power, marine, aircraft and missiles, diesel, or any other field. There's a Flexitallic Gasket to meet your needs — or Flexitallic will design one.

Flexitallic Gasket Company, Camden 2, New Jersey. Stocking Distributors for Standard Flexitallic Gaskets in principal cities.

# NEW
# HIGHLANDER
## COMPLETELY AUTOMATIC BOILER-BURNER UNIT



HIGHLANDER BOILER-BURNER

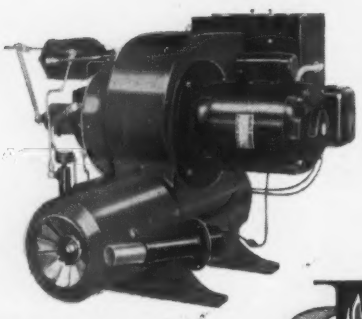
Certified rating for output. Underwriters' Laboratory Approved.

## PROVEN ECONOMY

SAVES ON INSTALLATION. The new Highlander is a completely assembled boiler-burner plant. Installing one simple unit saves money. Designed by Engineers with years of experience in matching burners and boilers for the exact job — whether it is power, processing or heating. No problem of taking a boiler and trying to match a burner to it. The Highlander Boiler-Burner unit is design-controlled at the factory.

SAVES ON OPERATION. Designed to get maximum economy from available fuels. The Highlander is built for low pressure or high pressure steam or hot water — Industrial Combustion burner furnished for a heavy oil, light oil or combination of gas/light or gas/heavy oil. Simple! Just 2 flue passes. Easy Maintenance! Boiler interior easily accessible. Reliable! Each burner is completely fire tested at the factory.

**YOUR CHOICE OF HEV-E-OIL, HEV-E-DUTY GAS or COMBINATION GAS and OIL BURNER**



HEART OF THE HIGHLANDER is the famous Industrial Combustion Burner. The HEV-E-OIL Burner engineered to use inexpensive No. 4, 5 and 6 heavy oils is shown here. Available from 5 to 150 gph. HEV-E-DUTY Power Gas Burners and Combination gas/oil Burners from 720,000 to 21,000,000 BTU.

Write Dept. J-61 for complete information.

**INDUSTRIAL COMBUSTION INC.**

EXECUTIVE OFFICES: 4447 N. OAKLAND AVE., MILWAUKEE 11, WIS.

**For more facts circle 307 on Reader Service card, p 121**


## Powerscope

Begins on page 172

### National grid system in Canada's future?

**Toronto** (*McGraw-Hill World News*) Interest is growing in a national power grid capable of shifting electricity between one part of Canada and another in substantial quantities. Nova Scotia and New Brunswick opened the only fully integrated power grid in Canada last September.

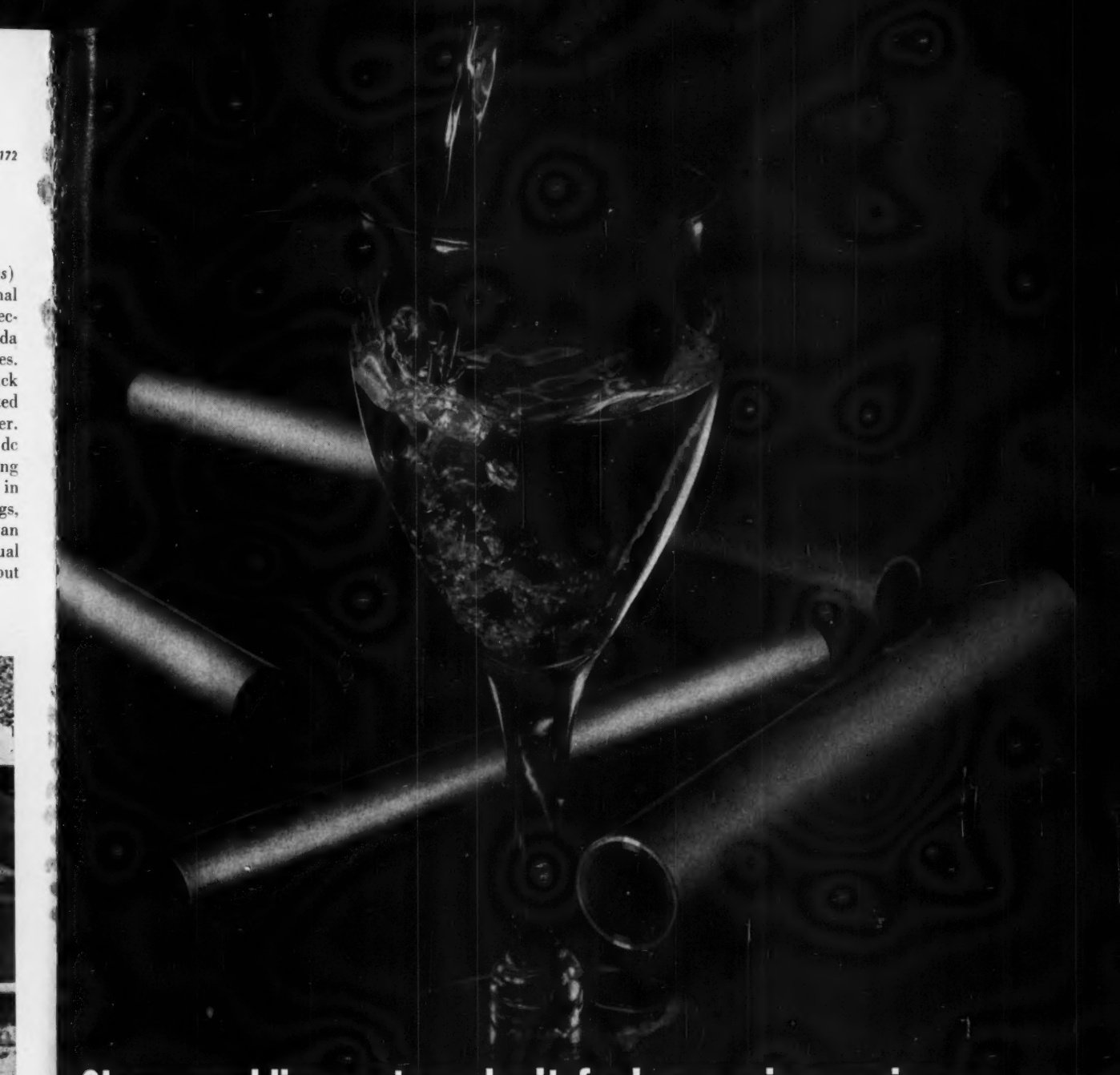
Estimated cost of a 3000-mile dc line is $150,000,000 with matching total for facilities to tap the line in seven provinces. David Cass-Beggs, general manager of Saskatchewan Power Corp, approximates annual operating cost at $35,000,000—but says savings would be more.

### Thawing station helps utility complete stockpiling

Baltimore Gas and Electric Company completed a 90,000-ton stockpile of coal on schedule at its new Charles P Crane Station despite a bad winter. Station receives its coal directly by rail. Thawing is required before the cars can be dumped and the coal sent to the stockpile.

A 1-man thawing station lets the company thaw up to two 5-car trains per hour. The 36 prefabricated thawing pits are arranged so any size car or combination of sizes can be

circle 308 on Reader Service card, p 121 ➤



# Clear sparkling waters don't fool corrosion engineers

Coupled with temperature, pressure and velocity, some waters can chew up condenser tubes faster than you would believe possible. Minute differences in oxygen, chemical or biological content give each a corrosive character of its own that calls for well-informed tube alloy selection.

Case histories in which tube life has been increased from months to *years*—or from years to many *more* years—are packed in Bridgeport's files. The training and experience of our corrosion specialists can help match the best tube alloy to your water supply—whether potable, saline, brackish or polluted.

Write for information on Bridgeport's regular or Duplex tubes—or call in a Bridgeport man for quick and practical assistance on your corrosion, erosion or bio-fouling problems.

**Bridgeport condenser and heat exchanger tubes in over 50 metals and alloys:**

INHIBITED ADMIRALTY
INHIBITED ALUMINUM BRASS
INHIBITED MUNTZ METAL
70-30 CUPRO NICKEL
90-10 CUPRO NICKEL
DEOXIDIZED ARSENICAL COPPER
INHIBITED ALUMINUM BRONZE
RED BRASS
ALLOY 77 MERCURY BRASS

...plus **DUPLEX TUBES**...in combinations of the above alloys, with carbon or stainless steel, aluminum, Monel,® nickel...or other metals.

## BRIDGEPORT BRASS COMPANY

Bridgeport 2, Connecticut

Bridgeport

# ROTO® Hand-hole Seat Scraper

Roto Hand-hole Seat Scraper for B & W Boiler.

**Eliminates tedious labor**

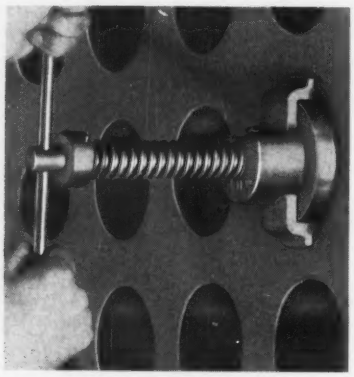
**Assures clean, tight fit**

**Roto Hand-hole Seat Scraper makes short work of cleaning dirty hand-hole seats. This simple, hand-operated tool has adjustable, spring-mounted retractable knives. A few turns to the right remove foreign matter without cutting the metal. A half turn to the left releases the tool, and the job is done. Customers say that the Roto Seat Scraper does the job up to 12 times faster than by any other method. Try one and you'll wonder how you ever got along without it. *Send for details.***

*Now available*

**for most hand-hole shapes and sizes**

**Standard Roto Seat Scrapers are available for the following equipment. Special types made to order.**



*Illustrating ease of operation of Roto Hand-hole Seat Scraper.*

| Type of Boiler | Opening | Tube Size |
|---|---|---|
| Babcock & Wilcox # 4 | Round | 2" |
| " " " #41 | Oval | 2" |
| " " " #70 | Round | 3" |
| " " " #48 | Oval | 3½" |
| " " " #40 | Oval | 3¼" |
| " " " #24 | Oval | 4" |
| " " " | Oblong | 4" |
| Bros | Round | 3¼" |
| Casey Hedges | Oval | 3½" |
| " " | Oval | 4" |
| Combustion Eng'rg | Round | 3" |
| " " | Oval | 3" |
| Edgemoor | Oval | 4" |
| Erie City | Ellip | 2½" |
| " " | Oblong | 3¼" |
| " " | Ellip | 3¼" |
| " " | Pear | 4" |
| Foster Wheeler | Oblong | 2½" |
| " " | Oblong | 3" |
| " " | Ellip | 4" |
| Geary | Oblong | 4" |

| Type of Boiler | Opening | Tube Size |
|---|---|---|
| Heine | Round | 3½" |
| " | Oval | 3½" |
| International Boiler 2 | Oblong | 3" |
| Keeler | Round | 3½" |
| " | Round | 4" |
| " | Diamond | 3½" |
| " | Diamond | 4" |
| Lasker | Oblong | |
| Murray | Oval | 3½" |
| " | Oblong | 4" |
| Oil City | Oval | 3½" |
| " " | Oblong | 4" |
| Riley Stoker | Ellip | 3¼" |
| Springfield | Ellip | 3¼" |
| Union Iron Works | Pear | 4" |
| Henry Vogt | Ellip | 3¼" |
| " " | Oval | 4" |
| Walsh & Weidner | Oval | 4" |
| Wickes | Ellip | 2½" |
| " | Ellip | 3¼" |
| " | Pear | 4" |
| " | Round | 4" |

**ELLIOTT COMPANY—ROTO PLANT**

*Tube Cleaner Specialists Since 1910*

1071-53 Bristol Road, Mountainside, N. J.




thawed without damage. Each pit radiates 1.5-million Btu per hour of heat. Some 6-million Btu per hour are available to each car.

Station is operated from three remote control panels installed on the trackside windbreak. Air-pressure, fuel or power-supply failure triggers automatic shutoff.

First step in thawing is manually igniting all pilots. Lead car is positioned over pits. Operator observes position of cars along track and starts up pits located under areas to be heated.

Thawing equipment is oil-fired. Fuel oil is pumped from power-plant storage tank to burners via an underground pipeline. Low-pressure blowers provide air for oil combustion.

## NEW reaches U. S., Canadian communities

National Electrical Week, Feb 5-11, was observed in more than 300 communities in the U. S. and Canada. Electrical-industry groups helped disseminate information and materials on the story of electrical use and its value to every American.

## Animals use electric company's service

Animals can make downright pests of themselves. Aside from rescuing the perennial cat who has clawed his way up a pole, the Cleveland Electric Illuminating Company has had to contend with low-flying geese hitting a main overhead transmission line and underground cable-chewing rats. If an unlucky squirrel touches two parallel electric wires simultaneously, resulting short circuit may affect service to whole neighborhood.

Schools of shad in Lake Erie have managed to swim through intake channels providing water for plant boilers. Screening apparatus keeps shad from swimming into pipes—but enough fish will pack the screen and keep the water out, too. But company philosophically takes the animal hazard in its stride.


**continued**

**NEW MORTON FLUITRON* ASSEMBLY ELIMINATES GRAVEL SUPPORTING BEDS**

# TAKE THE GRAVEL OUT OF YOUR BRINEMAKER AND KEEP IT OUT!

The all-plastic "Fluitron" is an exclusive Morton brinemaking device which makes possible exceedingly high brine flow rates while *completely eliminating* the need for gravel supporting beds when dissolving high-purity fine grained salts.

When used with Morton '999' or Purex all-soluble salts, the "Fluitron" insures a pure, saturated brine. It diffuses water through the salt bed and also collects the brine for discharge to the brine-use system. And by eliminating the gravel bed and expanding the salt capacity of your dissolving vessel, the "Fluitron" relieves you of frequent salt charging.

*Patent applied for



Adaptable to most brine make-up tanks, the "Fluitron" is included with Morton Model "E" Brinemaker series, or may be acquired individually on convenient leasing terms. Morton Brinemakers are now available in two corrosion-free materials —stainless steel or plastic. Write for complete information today.

☐ *Please send me complete information on Morton "Fluitron" and Brinemakers*

☐ *Please have a Morton Brine Engineer contact me regarding:*

*(type of problem)*_____

Name_____

Title_____

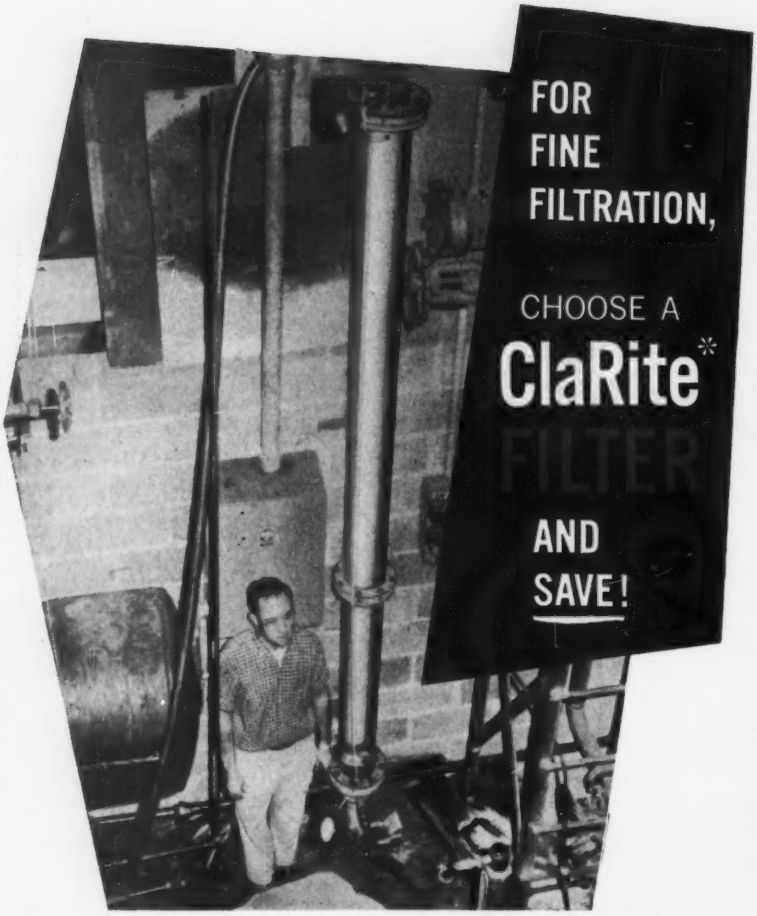
Company_____

Address_____

City_____ Zone____ State_____

**MORTON SALT COMPANY** Industrial Division
Dept. P6, 110 N. Wacker Drive, Chicago 6, Illinois

For more facts circle 310 on Reader Service card, p 121




*Undergoing laboratory testing at Croll-Reynolds: one of the ClaRite 'Wedgewire' filter elements for three 415 square-foot units designed to filter condensate in a high-pressure generating station*

**A ClaRite filter removes particles down to 1/10 of a micron by the precoat method — saves you money and floor space too**

This picture offers proof of precoating efficiency that no other filter tube can match. The 'Wedgewire'* tube is 9 feet long by 2¾ inches in diameter — yet it retains an even precoat over its entire length. As the effective length of the filter tube increases, the number of tubes needed to meet filter area specifications decreases proportionately.

**Q.E.D.:** Fewer filter tubes are needed in a ClaRite filter assembly and the pressure vessel may be smaller. You save three ways — on installation costs, on the cost of the pressure vessel, and on floor space.

Another feature of a ClaRite filter: It can be cleaned effectively and completely by the backwash method. Disassembly is not necessary.

A ClaRite filter has no moving parts. Rugged, permanent filter elements, heavy duty construction and high quality accessory components slash maintenance costs and permit operation at extreme pressure drops. ■ The exclusive design of the 'Wedgewire' element assembly allows faster flow rate than other types of equipment of equal area. ■ For a booklet describing the ClaRite filter, write to the Croll-Reynolds Engineering Co.

*Croll-Reynolds' trademark

**Croll-Reynolds Engineering Co., Inc.**

1122 MAIN STREET, STAMFORD, CONNECTICUT

*Representatives in principal cities*

**For more facts circle 311 on Reader Service card, p 121**

## Powerscope

*Begins on page 172*

### Helicopter tops out tower

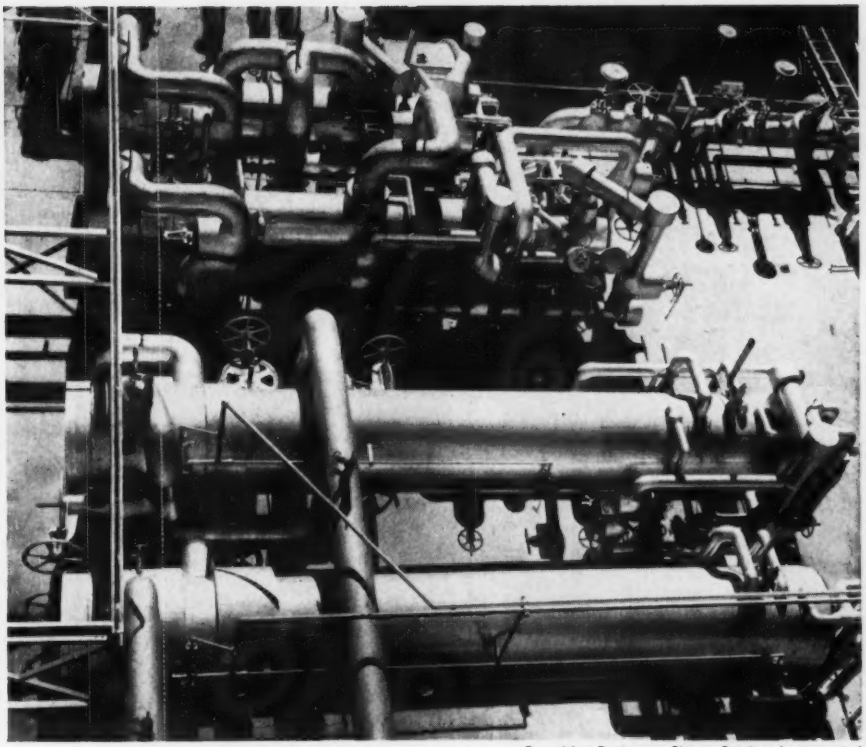
A 200-ft-tall transmission tower was topped out by a light utility helicopter airlifting 93 ft of structure in half-ton steel sections. Project took 4½-hr flying time. Tower, first of two built to span 115,000-v lines across channels in Coos Bay, Oregon was part of the 4-mile power line under construction by Pacific Power and Light Company to serve a new paper mill.

Barge-mounted crane had erected the lower 111 ft of the tower on concrete footings and remaining prebuilt sections were hooked to the helicopter. Riggers atop tower signaled helicopter into position and assembly was bolted into place. Conventional gin-pole erection would have taken five days.

### Air-conditioning for humans

Self-contained air-conditioned suit keeps wearer comfortable in outside temperatures from −40 to +135 F. Experimental model was developed by Westinghouse Electric Corp and the U. S. Naval Supply Research and Development Facility. Heating or cooling is done by thermoelectricity, eliminating need for conventional moving parts.

During cooling, the current flow through elements causes one end of the thermoelectric couples to cool, lowering the temperature of the heat exchanger on the inside of the suit. Heat removed from cool side flows



Consulting Engineers: Ebasco Services Incorporated

# 4,000 PSI 1,000 °F (OR EVEN HIGHER WHEN YOU NEED IT!)

***FEEDWATER HEATERS WITH YUBA'S EXCLUSIVE MULTILOK CLOSURE*** are capable in basic design of operating at the extreme pressures and temperatures required more and more by the power industry.

The Multilok Closure, a Yuba exclusive, is one of the important reasons why these units operate so efficiently and safely in the 4,000 PSI, 1,000° F range. And Yuba is prepared to produce units to handle even higher pressures and temperatures when needed. A pioneer in all-welded design, Yuba offers both all-welded and bolted construction – a complete and versatile line of feedwater heaters for high and low ranges, for every type of job. When space is a critical factor, as many as three low pressure stages can be combined in a single shell for a highly compact unit.

You'll want to discuss both design requirements and costs with Yuba heat transfer engineers during plant planning stages. The scope of Yuba designs will offer the best solution to your particular problem.

*Other Yuba products for steam power plants include condensers, evaporators, expansion joints, tanks, bridge and gantry cranes, structural steel erection, and scores of other items.*

YUBA

*specialists in power plant equipment*

YUBA HEAT TRANSFER DIVISION

## YUBA CONSOLIDATED INDUSTRIES, INC.

Sales Offices in Principal Cities



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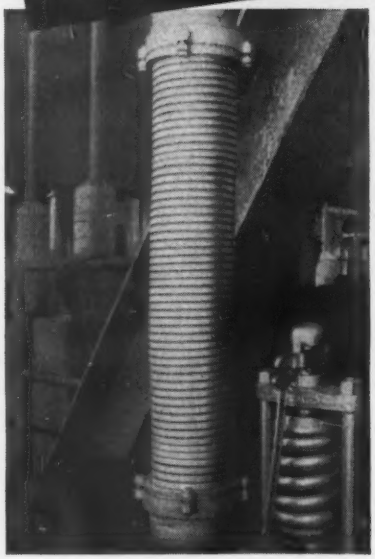
PENFLEX

• CUSHIONS SHOCK
• PREVENTS BREAKS



PENFLEX TUBING ABSORBS THERMAL EXPANSION SHOCKS

Thermal expansion 900°F . . . pressure up to 850 psi. . . . impact and pipe movement under terrific strain, but Penflex safely handles them all. That's the story of Penflex 8" I.D. stainless steel interlocked tubing welded into the pipeline, eliminating the cost of flanging the joint as well as the pipe. This was installed as an expansion joint on safety blow-off valves.

Wherever thermal expansion, pressures and shock are factors in keeping steam, air, water or chemical lines from breaking you can rely on Penflex Interlocked Tubing and Penflexweld High Pressure Tubing. Available in steel, bronze and stainless steel from ⅛" I.D. to 24" I.D. Write for complete details to Pennsylvania Flexible Metallic Tubing Company, Inc., Route 30, Paoli, Pa.

GET NEW DATA BOOK AND CATALOG

PENFLEX

TIGHT AS A PIPE BUT...

FLEXIBLE

circle 313 on Reader Service card, p 121

## Powerscope

Begins on page 172

through thermoelectric elements to hot-side heat exchanger. Then it's dumped into the atmosphere by a small fan. Another fan mounted on the same shaft circulates cool air within the suit. During heating, the two exchangers reverse functions.

Batteries will power suit for one hour.

### Impulse generator produces lightning bolts

Lightning doesn't strike often enough for the General Electric Company's extra-high-voltage testing project, so company has started to make its own.

Impulse generator produces up to 3-million v of electricity to flash over 22 insulators attached to transmission towers. This will provide data on insulator's strength to withstand switching surges and lightning effects. Results will be available to electric utilities planning EHV systems.

Switching surge is voltage that's generated by breaker operations when line is energized or de-energized. Voltage, double that of transmission, can cause flashover.

Discharge from generator is initiated by a rectifier transformer which steps up voltages from 220- to 84,000-v ac. Electricity passes through bridge type kenotron rectifier, becomes 120,000-v dc. Through charging resistors, connection is made to two stacks of 200 capacitors. Capacitors are charged in parallel and then connected in series through a cascading re-

P.F.I.

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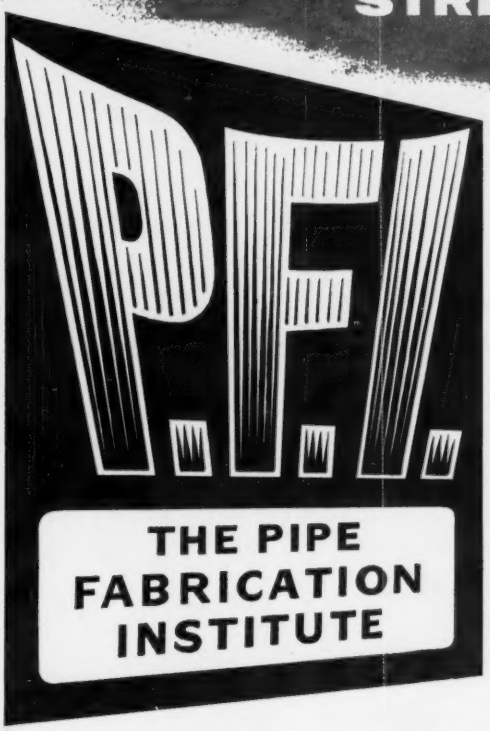


# Whatever Your Pipe Fabrication Needs

## USE THE SERVICES OF A P.F.I. MEMBER

The Pipe Fabrication Institute is *not* just another trade association with industrial relations its prime purpose.

PFI is a group of companies specializing in pipe fabrication who contribute funds and experienced manpower to research and to correlate facts and technical advancements for the purpose of improving pipe fabricating techniques.

This wealth of coordinated information relating to the establishment of high standards for high pressure and high temperature piping has been widely distributed through all industry. PFI publications covering this information are listed below and are free upon request.

So, when you select a piping fabricator, it's to your advantage to specify PFI member companies . . . your confidence will be rewarded by dependable service, engineering assistance and complete satisfaction in meeting exacting specifications.

*SEE LIST OF P.F.I. MEMBERSHIP ON OPPOSITE PAGE*

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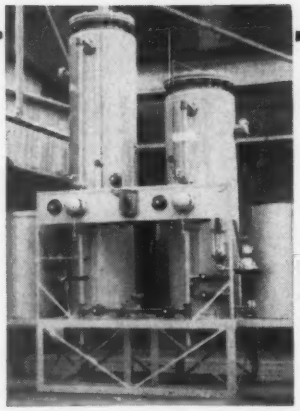
*Simply circle the Standards you can use and mail to PFI at the address above.*

1 Machining Backing Rings for Butt Welds
2 Dimensioning Welded Assemblies
3 Linear Tolerances Bending Radii
4 Shop Hydrostatic Testing
5 Cleaning Fabricated Piping
6 Built-up Weld, Metal Bosses
7 Welded Nozzles — Spacing
8 Preheat - Postheat Welding, Low Chrome — Moly Pipe
9 Arc-Welding Dissimilar Ferritic Steels
10 Stress Relieving Practices
11 Affixing Permanent Symbols to Piping
12 Preheat - Postheat Welding, Medium Low Chrome — Moly Pipe
13 Classification, Shop Testing, Inspection, Cleaning




For more facts circle 314 on Reader Service card, p 121



NEW FROM H&T
Low-Cost • High-Performance
"PACKAGE" DEMINERALIZERS!
TWO-BED and UN-A-BED STANDARD UNITS
NOW AVAILABLE!!

Unless *special* conditions require you to use a *special* demineralizing system, you can save big money—and get excellent results—with the new H&T Standard "PACKAGE" DEMINERALIZER! Into these superior Standard Units, we've put the experience of 16 years in building many hundreds of manual and automatic demineralizing systems. *Result:* H&T "PACKAGE" DEMINERALIZERS are masterpieces of design and construction—unequalled in performance and wonderfully low in cost.

*Write for details of Two-Bed and Un-A-Bed Demineralizers*

HUNGERFORD & TERRY, INC.
CLAYTON 3, NEW JERSEY

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DRAFT SHORTAGES?

REPLACE THE DRAFT DIVERTERS ON YOUR
GAS FIRED BOILERS

WITH DOUBLE-ACTING
FIELD DRAFT CONTROLS*

*to overcome draft shortages, permit increased firing rates*

*Field makes the draft assistance of the chimney available to the boiler for abundant draft at all firing rates, precisely controlled to the optimum twelve-to-one air-to-gas ratio recommended for clean, efficient combustion. Write for engineering data.

FIELD CONTROL DIVISION
Conco Engineering Works, Inc., Mendota, Illinois
AFFILIATES:
Spartan Tool Division—Powered Sewer Cleaning Equipment • Materials Handling Division—Cranes, Hoists • Conco Building Products, Inc.—Bricks, Tile, Stone

For 5'—34' Flues

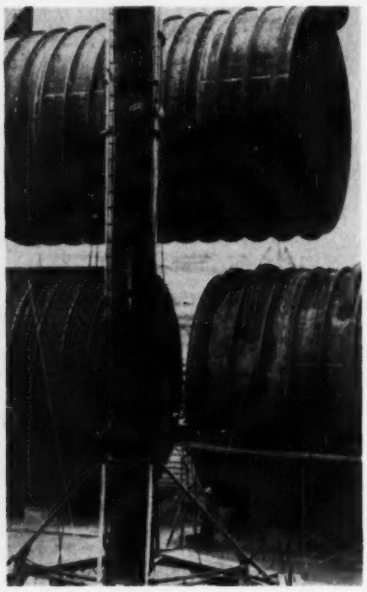
For more facts circle 316 on Reader Service card, p 121


## Powerscope

Begins on page 172

action of sphere gaps. Result: 3-million v for artificial lightning stroke and 2-million v for a switching surge.

Output voltage from impulse generator housed in nylon bubble is transmitted along a conductor which runs through top of bubble up to insulator string or transmission line.



### Cans to channel Missouri River

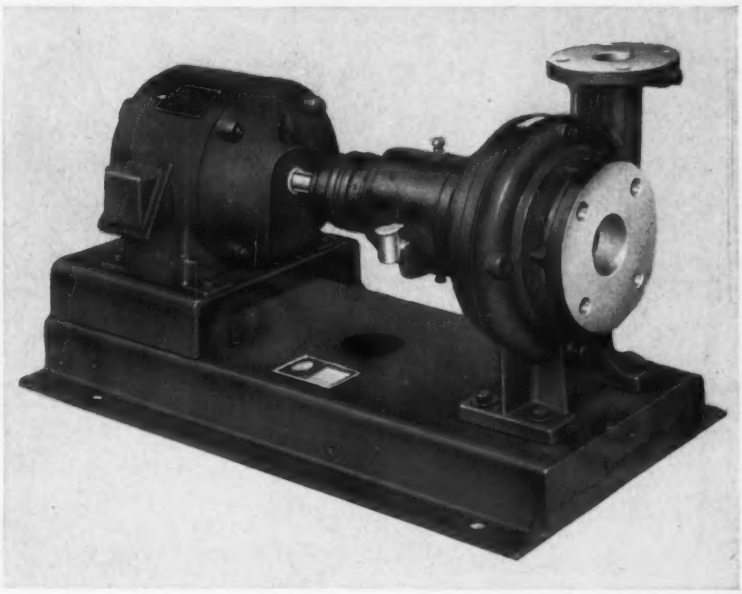
Over 400 60-ton steel cans will channel waters of the Missouri River. Cans will line 7 hydroelectric power tunnels at Oahe Dam—world's largest earth-filled dam now under construction near Pierre, S. D. When completed in 1964, dam will generate about 3-billion kwhr of electrical energy a year—enough for a city of a million people.

Liners are welded together under controlled temperatures in a fabricating shop. Rolled onto tracks at tunnel entrances, they are fitted to other liners and welded throughout. Welds are X-rayed. When tunnel lining is in place, openings are sealed and entire unit hydrostatically tested to 120 psi.

**Bonn** (*McGraw-Hill World News*) Power plant to be built within five years near Seoul, South Korea will have 110,000-kw capacity.

# prove it to yourself!

## ...THAT THE SERIES 1510-B CENTRIFUGAL PUMP OFFERS MORE



### 1510-B FEATURES

- Vertical split case design—solid-type volute can be left in pipe line when servicing pump.
- Removable bearing frame assembly—can be lifted out without disturbing piping or motor leads.
- Interchangeable bearing frame assembly—one unit fits a wide range of pump sizes.
- Positive oil lubrication with visual check.
- Anti-friction *roller bearings.*
- Mechanically balanced impeller. Balancing chamber and pressure relief holes in impeller reduce thrust to a minimum—lengthen pump life.
- Leak-proof "Remite" seal. Carbon seal ring faces on harder-than-glass Remite floating seat. Assures long, trouble-free life.
- Special alloy steel shafts, superfinished, oversized.
- Performance guaranteed—100% pre-tested at the factory for conditions of head and capacity specified.
- Choice of all-iron, bronze-fitted, or all bronze.
- Capacities to 2000 GPM, heads to 420 ft.

**Why not get your full dollar's worth of pump value...send today for selection data on the B&G 1510-B Centrifugal Pumps.**

### Check any centrifugal pump of comparable capacities against B&G 1510-B Pump features!

B&G Series 1510-B Centrifugal Pumps are distinguished by all the features listed at left. To compare any other pump with the 1510-B, place check marks in the red boxes beside the features also offered by the competitive pump.

*We'll wager you'll wind up with quite a number of unchecked boxes!*

The balanced design of this *vertical split case* pump is definite assurance of smoother, more efficient performance and longer life. Its design enables the bearings to withstand loads far in excess of those produced by any pump and motor combination in the 1510-B series ...an added feature of dependability.

**NOW AVAILABLE IN "C" SIZE UNITS UP TO 75 H.P.**
2000 GPM, 170 feet, 1750 RPM,
3"—4"—6"—8" discharge connections

**BELL & GOSSETT COMPANY**
**Dept. GR-36, Morton Grove, Illinois**

*Canadian Licensee: S. A. Armstrong, Ltd., 1400 O'Connor Drive, Toronto 16, Ontario*


For more facts circle 317 on Reader Service card, p 121

**BOILER FEED PUMPS**

# sealed 32,500 hours and more

***with no maintenance!***

"Still operating perfectly after almost four years of continuous boiler feed pump service," reports one user of Borg-Warner Type D Mechanical Seals. Other typical reports show 10,000—25,000—30,000 hours and more of trouble-free operation...and still going strong!

In addition to important savings in treated feed water and heat often lost through stuffingbox leakage, Borg-Warner Mechanical Seals have proved they can cut expensive down time and maintenance.

**Compare your seal performance...**

If your present sealing method is not giving the long, reliable performance you think it should, we invite you to compare your record with actual user reports of B-W Type D Seals. Your nearest Borg-Warner Mechanical Seal sales engineer will be glad to show you the proof! Already sold? Then write or call for the new Type D Seal bulletin with complete engineering and installation data for equipping your present boiler feed pumps with modern Borg-Warner Mechanical Seals!

**BORG-WARNER®**
**MECHANICAL SEALS**

P.O. Box 2017A Terminal Annex
Los Angeles 54, California


# Calendar

**June 5-7—Edison Electric Institute,** 29th Annual Convention, Waldorf-Astoria Hotel, New York. Details: EEI, 750 Third Ave, New York 17, N. Y.

**June 6-8—Instrument Society of America,** Instrument - Automation Conference & Exhibit, Royal York Hotel, Queen Elizabeth Hall, Toronto, Ont., Can. Details: Meetings Manager, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

**June 6-8 — 6th Annual Appalachian Underground Corrosion Short Course,** W. Va. U, Morgantown, W. Va. Details: J Alm, 2 Gateway Center, Pittsburgh, Pa.

**June 8-9 — National Electrical Manufacturers Assn,** Western Conference, Biltmore Hotel, Los Angeles, Calif. Details: NEMA, 155 E 44th St, New York 17, N. Y.

**June 11-14—Electrical Apparatus Service Association, Inc,** 28th Annual Convention, Jack Tar Hotel, San Francisco, Calif. Details: EASA, 7730 Carondelet Ave, St Louis 5, Mo.

**June 11-15 — American Society of Mechanical Engineers,** Summer Annual Meeting, Statler-Hilton Hotel, Los Angeles, Calif. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

**June 12—Air Pollution Instrumentation Symposium,** sponsored by ISA, APCA, Hotel Commodore, New York, N. Y. Details: Meetings Manager, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

**June 12-15 — National District Heating Association,** 52nd Annual Meeting, Wentworth - by - the - Sea, Portsmouth, N. H. Details: J F Collins Jr, NDHA, 827 N Euclid Ave, Pittsburgh 6, Pa.

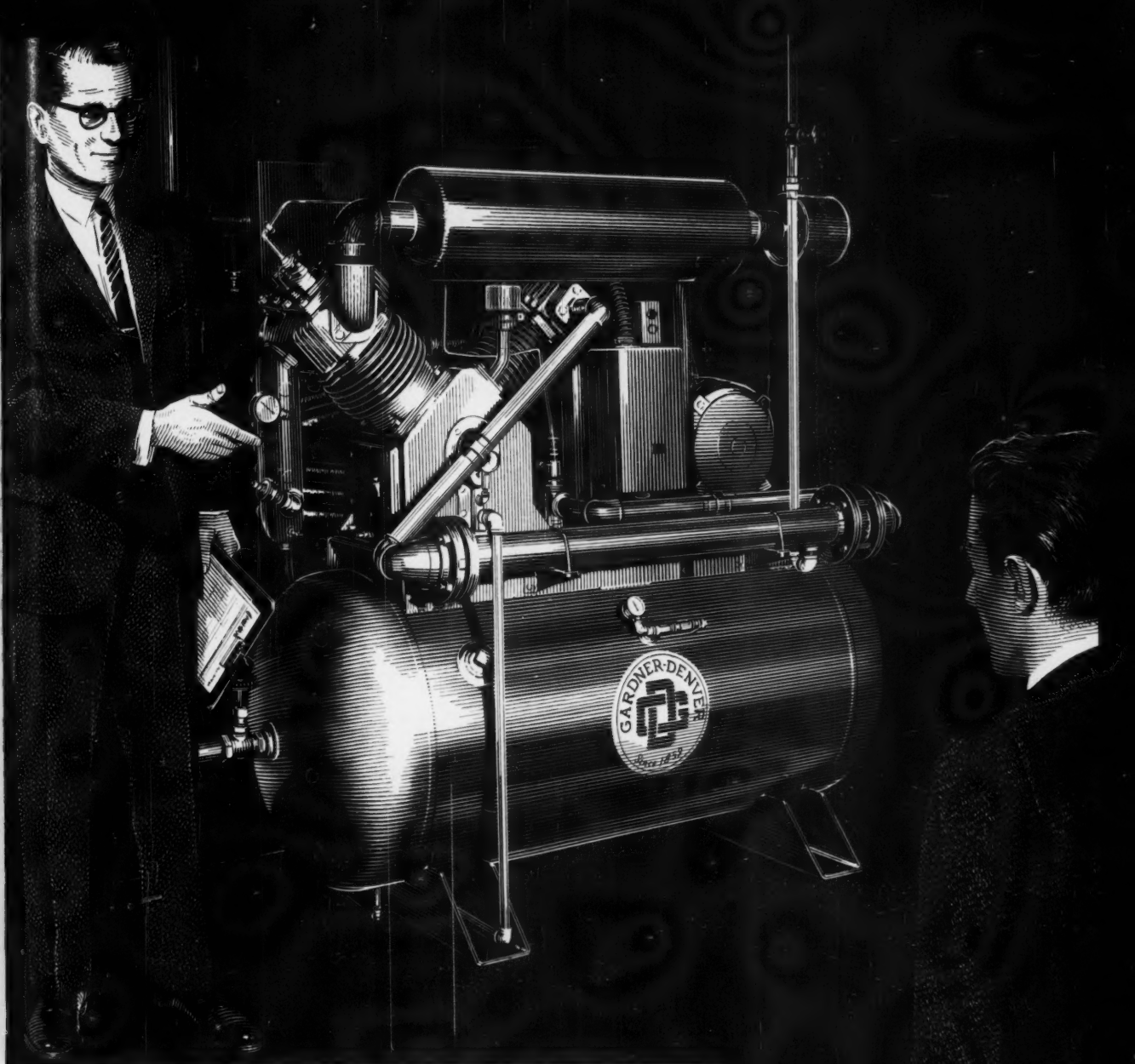
**June 14-16—Applied Mechanics Conference,** Ill. Inst of Technology, Chicago, Ill. Details: ASME Meetings Dept, 29 W 39th St, New York 18, N. Y.

**June 18-23—American Institute of Electrical Engineers,** Summer



For more facts circle 318 on Reader Service card, p 121

circle 319 on Reader Service card, p 121 ➤




## "Runs quiet and cool"

. . . because this Gardner-Denver air-cooled compressor is installed complete with aftercooler and silencer. Provides dependable, low-cost air power . . . is ideal for departmental or auxiliary air power. Runs for years with just routine attention. Choose from a complete air-cooled line. Write for bulletin.

Gardner-Denver Company, Quincy, Ill.—Offices in principal U.S., Canadian and Mexican cities.
In Canada: Gardner-Denver Company (Canada), Ltd., 14 Curity Avenue, Toronto 16, Ontario.

International: Gardner-Denver International Division, 233 Broadway, New York 7, N. Y.
Offices: Buenos Aires, Argentina; Artarmon, N.S.W. Australia; Brussels, Belgium; Rio de Janeiro, Brazil; Santiago, Chile; Barranquilla, Colombia; Lima, Peru; Ndola, N. Rhodesia; Salisbury, S. Rhodesia; Johannesburg, Transvaal.

GARDNER-DENVER
Since 1859

EQUIPMENT TODAY FOR THE CHALLENGE OF TOMORROW

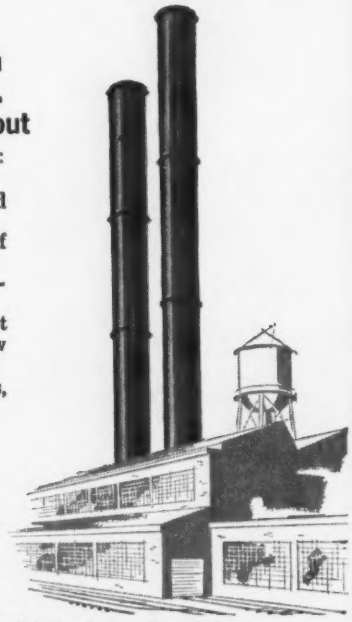
# GARDNER - DENVER

**unless you're equipped with A. O. Smith smokestacks . . . glass-protected inside and out**

Glass-protected smokestacks give you:

- A selection of colors
- 3 to 5 times longer life than unlined steel stacks
- Corrosion resistance regardless of excess acid condensate
- Low maintenance, no painting — glass can't rust
- Light weight—lower foundation cost
- Lower cost — glass protection now within reach of all

For bulletin containing all the facts, write Dept. P-61.



*Through research ...a better way*

**A.O.Smith**
CORPORATION

**SMOKESTACK SALES**
PROCESS EQUIPMENT DIVISION
P. O. BOX 584 • MILWAUKEE 1, WISCONSIN

**For more facts circle 320 on Reader Service card, p 121**

*Don't take chances on couplings*

**CHECK PUBLISHED MISALIGNMENT RATINGS BEFORE YOU BUY**

Since misalignment is the basic problem that shaft couplings are designed to solve you'll find a published conservative misalignment rating (along with load capacity rating) for every Fast's Coupling. Compare it with the misalignment rating of any other coupling you are considering.

One further advantage of Fast's Couplings' misalignment ratings: You save money on installation because, knowing the ratings, you don't have to line up driving and driven elements with pinpoint accuracy. It's one more important reason why Fast's Couplings are the choice of more equipment manufacturers than any other gear-type coupling. KOPPERS COMPANY, INC., 1106 Scott Street, Baltimore 3, Md.

KOPPERS

**FAST'S COUPLINGS**
Engineered Products Sold with Service

**For more facts circle 321 on Reader Service card, p 121**


## Calendar

Begins on page 186

General Meeting, Cornell U, Ithaca, N.Y. Details: AIEE, 39 W 39th St, New York 18, N. Y.

**June 19-30 — Semiconductor Theory and Technology Course,** U of Mich., College of Engineering. Details: R E Carroll, U of Mich., 126 W Engineering Bldg, Ann Arbor, Mich.

**June 26-Aug 18 — Elements of Nuclear Power Reactor Engineering Course,** U of Mich., College of Engineering. Details: R E Carroll, U of Mich., 126 W Engineering Bldg, Ann Arbor, Mich.

**June 25-30 — American Society for Testing Materials,** Annual Meeting, Chalfonte-Haddon Hall Hotel, Atlantic City, N. J. Details: ASTM, 1916 Race St, Philadelphia 3, Pa.

**June 26-28 — American Society of Heating, Refrigerating and Air-Conditioning Engineers,** 68th Annual Meeting, Denver Hilton Hotel, Denver, Colo. Details: J H Cansdale, ASHRAE, 234 Fifth Ave, New York 1, N. Y.

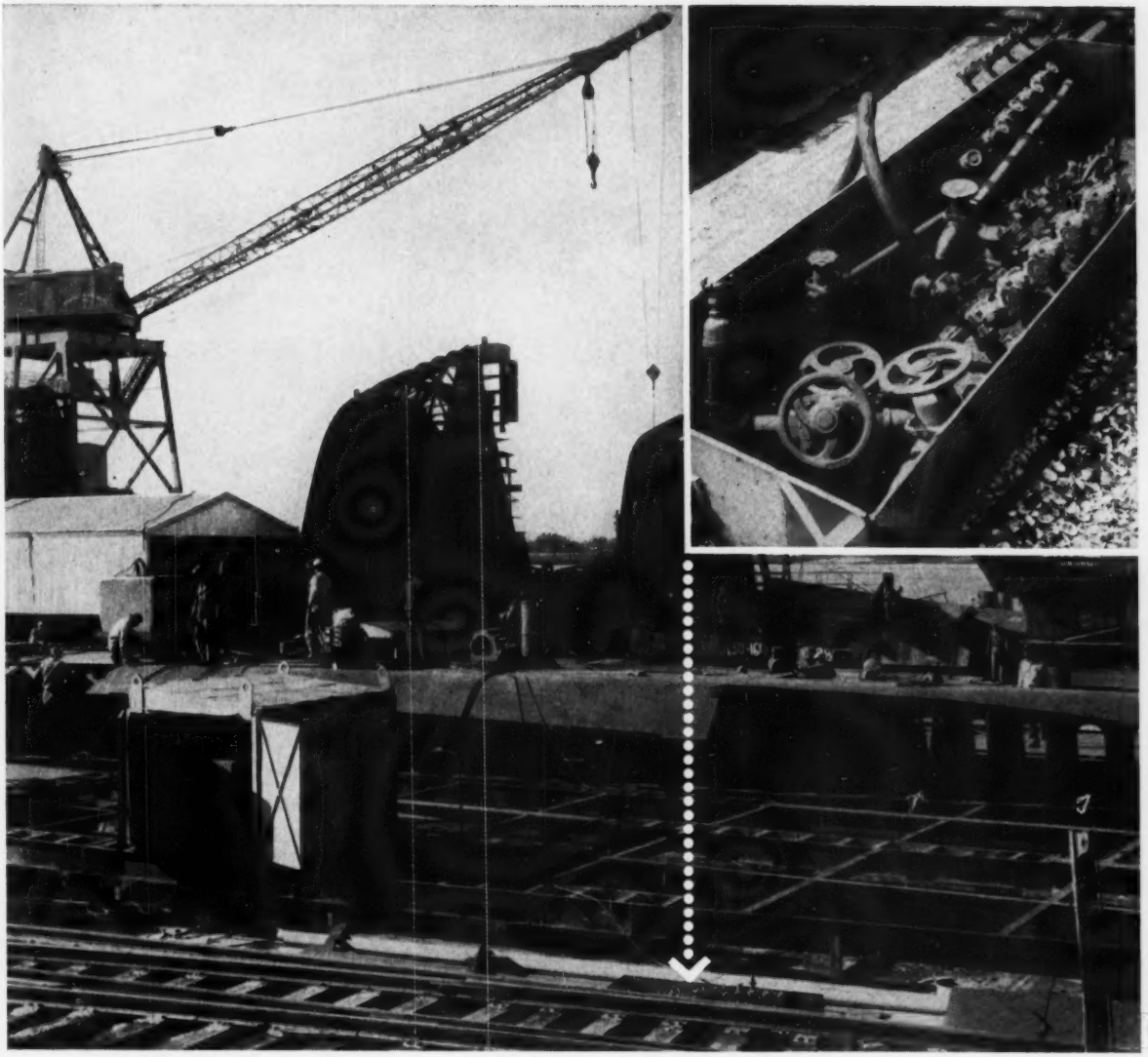
**June 28-30 — 2nd Joint Automatic Control Conference,** sponsored by ISA, AIChE, AIEE, ASME, IRE, U of Colorado, Boulder, Colo. Details: Meetings Manager, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

**July 18-20—Western Plant Maintenance & Engineering Show & Conference,** Pan Pacific Auditorium, Los Angeles, Calif. Details: Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

**Aug 21-31—United Nations Conference on New Sources of Energy,** Food and Agriculture Organization headquarters, Rome, Italy. Details: A G Katzin, Office of Public Information, United Nations, N. Y.

**Aug 23-25 — 4th Biennial Gas Dynamics Symposium,** sponsored by American Rocket Society and Northwestern U, at Northwestern. Details: Mechanical Engineering Dept, Northwestern U, Evanston, Ill.

continued



# 5000 Grinnell-Saunders Diaphragm Valves handle the tough jobs at Avondale Shipyards, Inc.

**"on air, fuel gases and raw river water... these valves are completely leak-proof and maintenance-free... paid for themselves in a short time"**

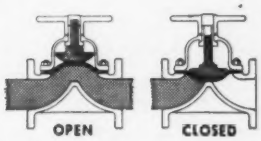
**– A. J. Planche, Pipe Supt.**

Compressed air . . . natural gas . . . acetylene . . . dirty river water are tough materials for valves to handle! Yet rugged Grinnell-Saunders Diaphragm Valves have been doing it for almost 4 years at Avondale Shipyards, Inc., New Orleans.

Big problem in handling compressed air and fuel gases: *leaking!* No problem for Grinnell-Saunders Diaphragm Valves! No packing glands to replace, no seats to replace, no leaking — and no dangerous underground gas pockets!

Big problem in handling silt-and-sand-saturated river water: *erosion.* No problem for Grinnell-Saunders Diaphragm Valves! Diaphragms isolate vital working parts — seal tight, too, in spite of abrasive particles in the water.

Grinnell-Saunders Diaphragm Valves are available in a wide choice of body, lining and diaphragm materials. Handwheel or power operated. For complete information, write Grinnell Company, Providence 1, Rhode Island.

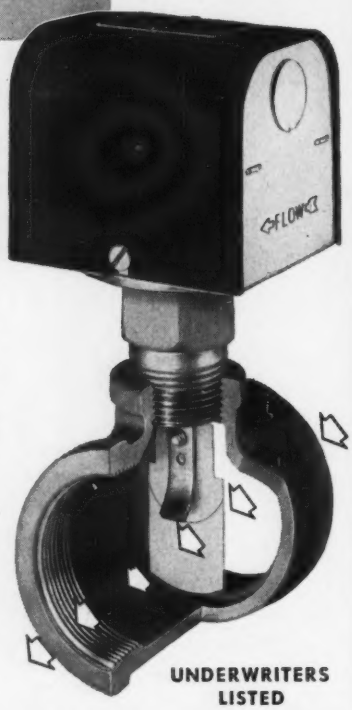



GRINNELL

Pipe Fittings, Valves, Pipe Hangers, Prefabricated Piping, Unit Heaters and Piping Specialties • Branch Warehouses and Distributors from Coast to Coast

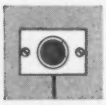
# McDONNELL *Flow Switches*

**FS4 Series Flow Switch shown mounted in a 2 inch Tee**

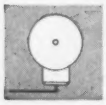



## *Here's what they do!*

What you see here is a compact, well-built switch that makes or breaks a circuit (as required) when liquid flows or stops flowing. It's an economical and positive way to start or stop anything electrically operated. Just to highlight a few uses:

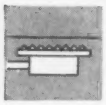


**to actuate a signal light**—signal an attendant to make the right moves in operating valves, pumps and the like—signal him when flow stops in a water cooled compressor, water cooled bearing and so on.

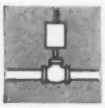


**to sound an alarm**—when flow stops in a process system or in any water cooled devices.

**to start or stop motors**—start pumps in sequence in multiple stage flow systems; start standby pumps; stop automatically controlled units if cooling water system fails; stop compressors in cooling systems when flow stops.



**to start or stop automatic burners**—start a booster heater when water draw occurs, stop burner if flow is improperly retarded; make sure of circulation in a boiler before burner is permitted to start.



**to actuate metering device**—open valve in chemical feeder line; start mixing in secondary line whenever flow starts in primary line.

**UNDERWRITERS LISTED**

Positive snap action switch. Easy to install and wire. Segmented paddle fits any pipe from 1" through 3". Unit shown handles pressures to 100 psi, temperatures to 300° F., in these types:

**FS4-3**—SPDT switch. Opens and closes two separate circuits with flow; closes and opens same two circuits with no flow.

**FS4**—Closes with flow; opens with no flow.

**FS4R**—Opens with flow; closes with no flow.

***NOTE:*** Model E-2 available for larger pipes, pressures to 150 psi.

**McDONNELL & MILLER, *Inc.***
**3506 N. Spaulding Ave., Chicago 18, Ill.**
*Doing One Thing Well*

**Coupon brings bulletin**
—covering design, construction, electrical ratings, dimensions, typical applications.

Please send me a copy of Flow Switch Bulletin FS1-A.

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Address_____

City, Zone, State_____

By_____

Mail to: McDonnell & Miller, Inc., 3506 N. Spaulding Ave., Chicago 18, Ill.

For more facts circle 323 on Reader Service card, p 121


## Calendar

*Begins on page 186*

**Aug 28-Sept 1 — International Heat Transfer Conference,** U of Col., Boulder, Col. Details: ASME, Meetings Dept, 29 W 39th St, New York 18, N. Y.

**Aug 30-Sept 1—American Institute of Mining, Metallurgical and Petroleum Engineers, Inc,** 3rd Annual Semiconductor Conference, Ambassador Hotel, Los Angeles, Calif. Details: AIME, 29 W 39th St, New York 18, N. Y.

**Sept 3-8 — American Chemical Society,** National Meeting, Chicago, Ill. Details: R Avery, ACS, 2 Park Ave, New York 16, N. Y.

**Sept 6-8—Joint Nuclear Instrumentation Symposium,** sponsored by ISA, AIEE, IRE, N. C. State College, Raleigh, N. C. Details: Meetings Manager, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

**Sept 11-15—Instrument Society of America,** Fall Instrument-Automation Conference & Exhibit, 16th Annual Meeting, Memorial Sports Arena, Los Angeles, Calif. Details: Meetings Manager, ISA, 313 Sixth Ave, Pittsburgh 22, Pa.

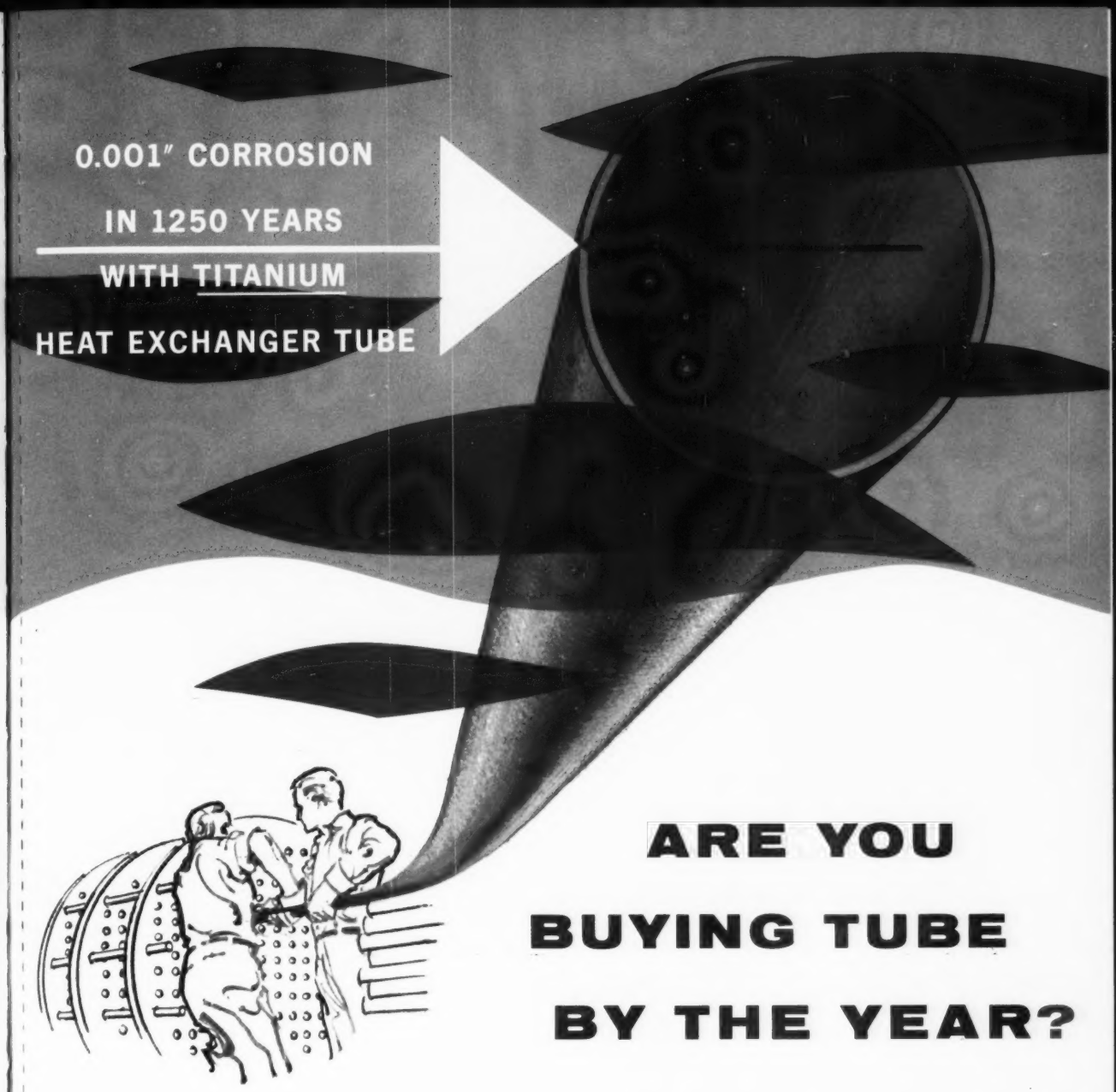
**Sept 14-15 — Engineering Management Conference,** American Society of Mechanical Engineers, American Institute of Electrical Engineers, Hotel Roosevelt, New York, N. Y. Details: ASME, 29 W 39th St, New York 18, N. Y.

**Sept 25-28—Industrial Building Exposition & Congress,** New York Coliseum. Details: Clapp & Poliak, Inc, 341 Madison Ave, New York 17, N. Y.

**Sept 24-27—American Institute of Chemical Engineers,** Meeting, Lake Placid Club, Lake Placid, N. Y. Details: AIChE, 25 W 45th St, New York 36, N. Y.

**Sept 24-29—Illuminating Engineering Society,** National Conference, Chase Park Plaza Hotel, St. Louis, Mo. Details: A D Hinckley, IES, 1860 Broadway, New York 23, N. Y.

circle 324 on Reader Service card, p 121 ➤




# ARE YOU BUYING TUBE BY THE YEAR?

If a shortage of fresh water for heat transfer operations is causing your company to use sea water or brackish waters for heat removal duty, here are some mighty important facts for your consideration:

(1) In salt water service, the corrosion rate of commercially pure titanium tubing has been calculated at 0.001" in 1250 years. In addition, tubing manufactured from titanium is immune to stress corrosion cracking in this type of service. Tests also indicate no apparent tendency toward crevice corrosion nor is there any indication of pitting from marine growth deposits.

(2) On the other hand, the tendency of some ferrous and nonferrous metals toward corrosion cracking and pitting with corrosive elements on the tube side and sea or brackish water on the shell side makes frequent maintenance and material replacement a costly procedure . . . TITANIUM ELIMINATES THIS COMPLETELY.

(3) Because of its resistance to corrosion in this type of service, thin walled titanium tubing can be specified as can thinner sections for other components. The result is greater heat transfer efficiency and, because of greatly increased operating life, a lower prorated cost per foot for titanium heat exchanger tube . . . the tubing that gives *years* of service instead of only *months*.

This is but one of a number of areas where Wolverine titanium heat exchanger tube can bring increased heat transfer efficiency at lower costs. Why not have Wolverine Tube's Field Engineering Service staff analyze your heat transfer operations? All you have to do is fill in and mail the data sheet on the reverse side of this page. There is no obligation. Do it today!

**WOLVERINE TUBE**
DIVISION OF
**Calumet & Hecla, Inc.**
DEPT. N, 17268 SOUTHFIELD RD., ALLEN PARK, MICH.
*TUBEMANSHIP in Copper—Copper Alloys—Aluminum—Special Metals*

PLANTS IN DETROIT, MICH. AND DECATUR, ALA.
SALES OFFICES IN PRINCIPAL CITIES

# TITANIUM COMPARISON CHECK SHEET

**WOLVERINE TUBE**
17268 Southfield Road
Allen Park, Michigan

**GENTLEMEN:**

We are interested in the possibility of using titanium heat exchanger tubing in our heat transfer operations. Will you please have your Heat Transfer Specialists analyze the following technical data and advise us if Wolverine titanium heat exchanger tube would be practical under the following conditions?

**PLEASE ANSWER ALL QUESTIONS AS COMPLETELY AS POSSIBLE**

1 What is O.D. of material? Wall Size? Quantity? Alloy?

2 Describe corrosive product with percent of concentration.

3 What is maximum temperature of corrosive product?

4 What is tube side operating pressure?

5 Is environment oxidizing or reducing?

6 What is present tube life?

TEAR OUT HERE

## FILL IN AND MAIL

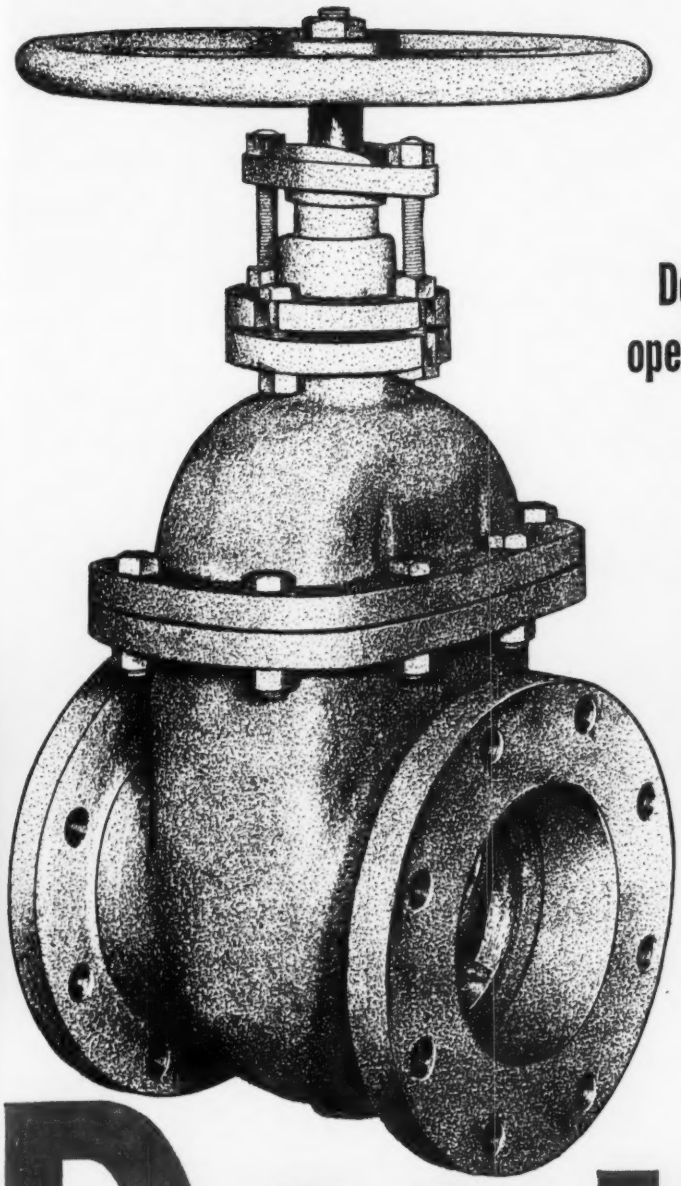

WOLVERINE TUBE
DIVISION OF
Calumet & Hecla, Inc.
DEPT. N, 17268 SOUTHFIELD RD., ALLEN PARK, MICH.
*TUBEMANSHIP in Copper—Copper Alloys—Aluminum—Special Metals*


NAME _____ TITLE _____

COMPANY _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____



## Dependable Darling Gate Valves open fully, close tight—with ease

The fully revolving double disc parallel seat and wedge design minimizes friction, avoids concentration of wear, and automatically compensates for valve seat deflection.

Gate discs are independently hung and free to revolve. They change their seating position at each closing. All working parts are perfectly plain. There are no pockets to collect sediment or prevent free and easy movement.

For assured ease of operation, minimum maintenance, long trouble-free service life, *you can depend on Darling*. Our engineers are always glad to assist you in determining the right valves for your service conditions. Darling Catalog No. 57 gives complete specifications. Write for your copy today.

**DARLING VALVE & MANUFACTURING CO.**
Williamsport 8, Pa.

*Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ontario, Canada*
*Vannes Darling-France, 23 rue du Commandant Mouchotte, St. Mandé, France*

TEAR OUT HERE

YOU CAN DEPEND ON

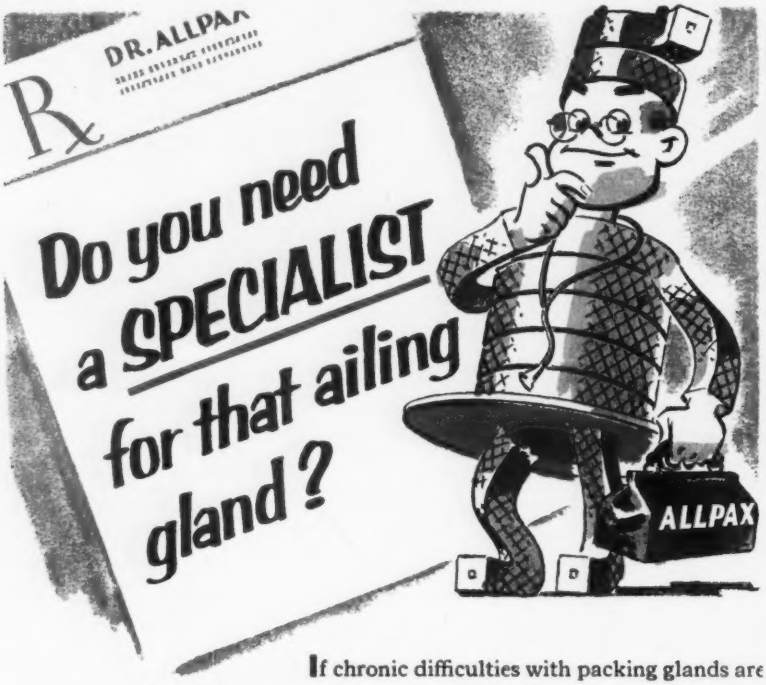
# DARLING

TRADE DARLING MARK

GATE • BUTTERFLY • CHECK • SPECIAL VALVES • FIRE HYDRANTS



For more facts circle 325 on Reader Service card, p 121



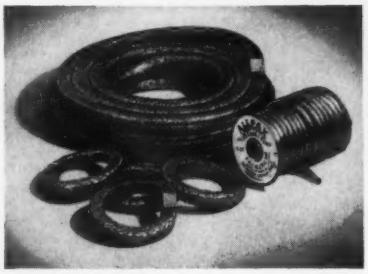

If chronic difficulties with packing glands are demanding more than their share of maintenance time, let Allpax prescribe for you. In our complete line of mechanical packings, we are sure to have the remedy you need. If your problem is a special one, Allpax will be happy to diagnose your case and design a special packing for your particular requirement.

Allpax packings cut costly downtime to a minimum, and eliminate undue wear and tear on expensive machinery. Contact your nearest distributor or write to the Allpax Applications Consultant at our factory.

*A complete selection of:*

- ✓ Teflon* Packings
- ✓ High Pressure Packings
- ✓ Metallic Packings
- ✓ Plastic Packings
- ✓ Sheet Packings

*DuPont Trademark



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ALLPAX

*"The Packing that Packs All"*

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A complete line of packing, tools, gasket materials
Distributors in principal cities

THE ALLPAX COMPANY, INC.
160 Jefferson Ave., Mamaroneck, N. Y.
CANADIAN DISTRIBUTORS: Albion Asbestos Packings Ltd., Montreal 18, Quebec


# Appointments

## Management changes

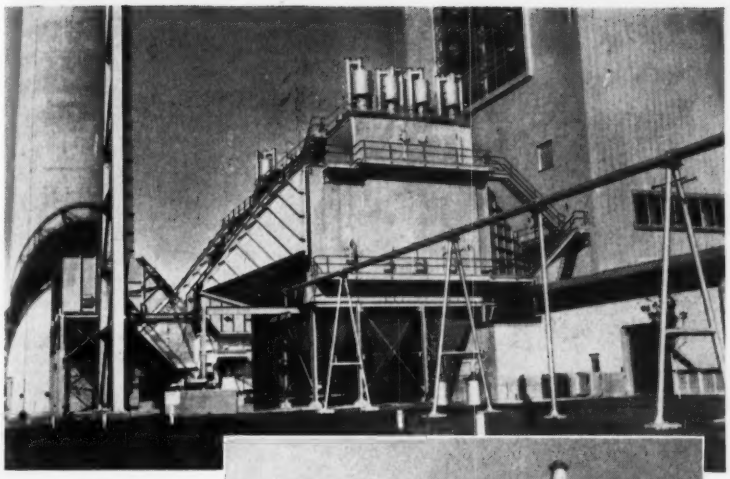
**Detroit Edison Co:** H C Reasoner, director, general-engineering dept. **Atomics International Div, North American Aviation, Inc:** Dr H Reiss, associate director of research dept. **General Electric Co:** O L Dunn, vice-president. **The Shawinigan Water and Power Co:** J A Smith, vice-president, production and power operations; J Bouchard, vice-president, distribution; D King, vice-president, system planning and engineering dept.

**South Carolina Electric & Gas Co:** C M Oyer, vice-president and treasurer. **The Southern Co:** J F Crist, executive vice-president; T H Vaden, vice-president of Birmingham Office. **Southern Electric Generating Co:** A W Vogtle Jr, president.

Melbourne A Forrest

**Burns and Roe, Inc** announces election of Melbourne A Forrest, vice-president, to the Board of Directors. He has held the posts of assistant to the executive vice-president, director of executive engineering and power and industrial facilities. Forrest's new area of responsibility will be in power, nuclear and industrial fields, defense and aeronautical facilities.

**Yale & Towne Mfg Co,** Yale Materials Handling Div: P R Hartig, vice-president and general manager. **Melpar, Inc:** T Meloy, chairman of the board; E M Bostick, president



Research-Cottrell precipitator at a 150,000 KW generating station cleans over half a million cubic feet of gas per minute with 99% collection efficiency.

Con Edison's 350,000 KW generating station at Arthur Kill, Staten Island, has Research-Cottrell precipitators guaranteed to collect 99% of the fly ash from 1,400,000 cubic feet per minute of combustion gases.

# Why These Plants Specify 99% Collection Efficiency

**Industry's concerted efforts to solve the *air pollution* problem has resulted in an increased demand for 99% collection efficiency guarantees. Only through a continuing program of product improvement has Research-Cottrell made these 99% guarantees economically feasible. Efficient voltage application; specific control of electrical sections; opzel collecting plates; automatically controlled, fully adjustable electrode rapping for optimum operation; accurate internal baffling; proper gas flow patterns through three-dimensional model studies—these are a few of the reasons why Research-Cottrell has been able to increase collection efficiencies without increasing the size of the precipitator.**

## Research-Cottrell Extra Premium Experience and Know-How

Past performance and reliability are the two major barometers of experience and know-how.

These are the factors which have inspired confidence in Research-Cottrell products as exemplified in the most recent independent central station surveys made by Power and Electrical World magazines.

### 1960 SURVEYS of Typical Power Stations by both POWER and ELECTRICAL WORLD Magazines

| | Research-Cottrell Equipment | |
|---|---|---|
| | Power | Electrical World |
| Percentage of Total Installations In Survey | 36% | 39% |
| Percentage of Total Precipitators In Survey | 39% | 35% |
| Percentage of Total Gas Cleaning Capacity In Survey | 45% | 42% |

These surveys covered 47 modern central stations including over 75 electrostatic precipitators for air pollution control. In each survey, there were more Research-Cottrell installations reported than for any other of the half dozen manufacturers in the field.

Make sure you receive the "extra premium" which goes with every Research-Cottrell product—experience and know-how.

Research-Cottrell Personnel are capable of handling any problem in the field of gas cleaning and will gladly assist you with your application.

**For more information on Research-Cottrell's program of product improvement, contact our local representative or write to the home office.**

**Research-Cottrell**

**RESEARCH-COTTRELL, INC. Main Office and Plant: Bound Brook, New Jersey**

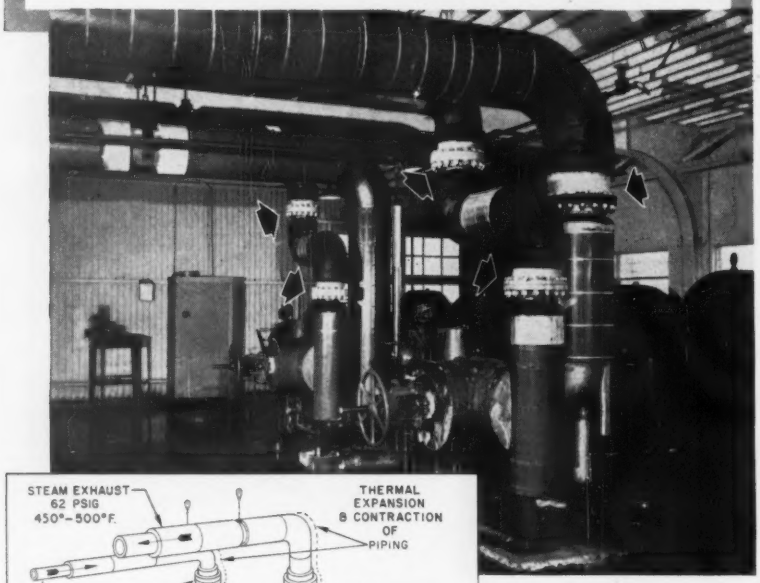
**Representatives in principal cities of U. S. and Canada.**

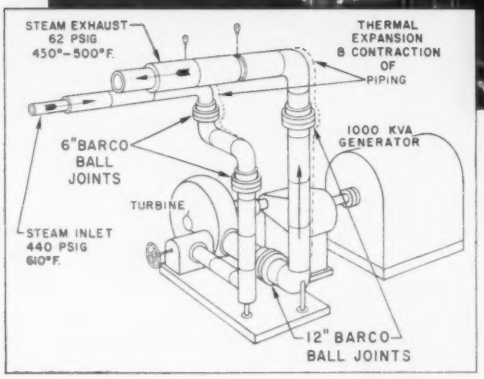
RC225



For more facts circle 327 on Reader Service card, p 121

# Barco Handles Expansion on Steam Turbine Piping–






BARCO

**BALL JOINTS**

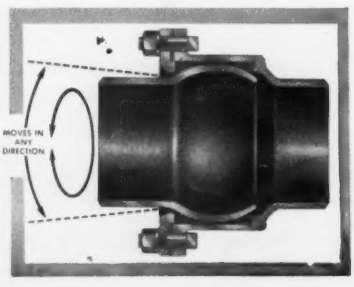
**1. Handle Expansion** **2. Relieve Torsion** **3. No "End Thrust"**

**PROBLEM** For the turbine installation shown above, layout of the piping presented involved pipe stress calculations to allow for thermal expansion and to eliminate torsional effects. In addition, a considerable expenditure had to be allocated to cover construction of heavy pipe anchoring and to control expansion "end thrust". *Could engineers find a better way to solve these problems? THEY DID!... and they saved about $2,000.00.*

**ANSWER** Instructions were simple: (A) "Install Barco Ball Joints —two* in each riser near turbine." (B) "Cut loose anchor stops; allow piping to move freely in all directions." (C) "Use spring hanger supports for the long horizontal runs of piping."

*Standard Type N for exhaust; High Temperature Type HT Joints for steam inlet lines.

Barco Ball Joints provide convenient points of flexibility in piping to allow for both expansion and twisting. They develop NO "END THRUST"; expensive anchoring is not required. Easy to engineer. Rugged all-steel construction with no thin wall sections, no critical points of fatigue, no rubber seals. No lubrication required. Sizes and styles to meet your requirements. *Ask for new Bulletin 31B, "Thermal Expansion and Contraction in Piping."*




**BARCO MANUFACTURING CO.**

5226 Hough Street, Barrington, Illinois

In Canada: The Holden Co., Ltd., Montreal


## Appointments

Begins on page 194

and chief executive officer; A C Weid, executive vice-president; W G James, special assistant to vice-president for advanced development. **North American Mogul Products Co:** A W Pugsley, chairman of the board; C C Tippit, president and treasurer.

**ALCO Products, Inc:** W A Callison, board of directors. **Thomas Flexible Coupling Co:** H B Cummings, president; N Kay, senior vice-president. **The Henry Pratt Co:** F D Crowther, president; E B Gottingham, chairman of the board of directors. **Norton Co:** R F Gow, president; M P Higgins, chairman of the board; J Jeppson, executive vice-president; R Cushman, R M Nichols, directors.

**Whitlock Mfg Co:** G Bennett, president. **The Fafnir Bearing Co:** H B Van Dorn, vice-president in charge of engineering; H L Potter, director of engineering. **Raybestos-Manhattan, Inc, Manhattan Rubber Div:** S R Zimmerman Jr, executive vice-president. **Westinghouse Electric Corp:** G L Wilcox, vice-president and assistant to president. **De Laval Steam Turbine Co:** M B Sennet, asst to vice-president.

### P J Rempe, L S Storrs

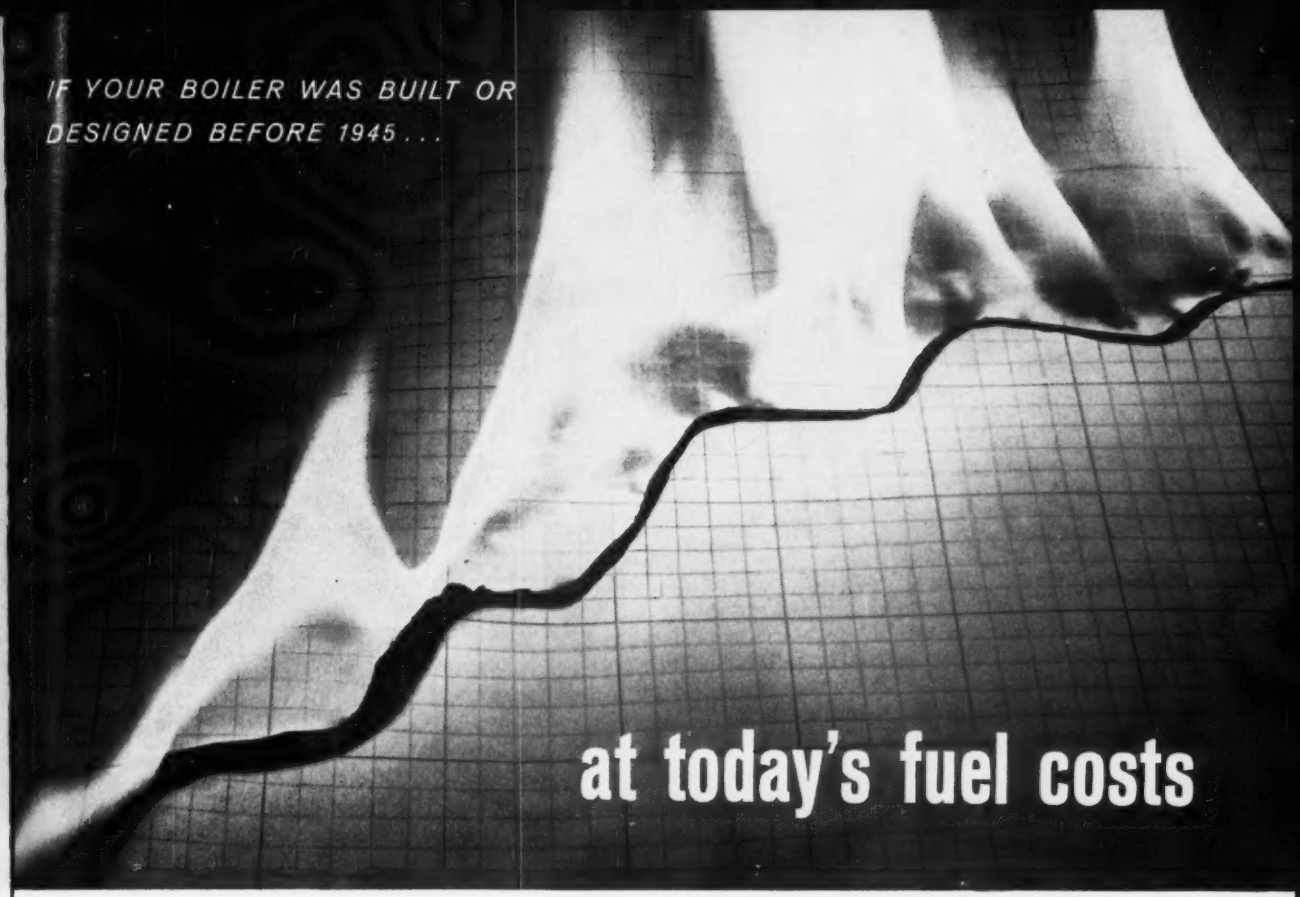
**Stone & Webster Service Corp** elected Peter J Rempe chairman of the board and chief executive officer; Lucius S Storrs Jr, president. As chairman, Rempe succeeds Richard N Benjamin, president of the parent company.

Formerly with El Paso Electric Company, Rempe has served as vice-president of the Service Corp, senior vice-president, director and president.

Storrs was elected a vice-president of the Service Corp, director and, in 1959, executive vice-president.

### Charles H Weaver

**Westinghouse Electric Corp** vice-president Charles Weaver has been elected president of Atomic Industrial Forum. A nonprofit association made up of business and professional organizations, labor groups, educational institutions and governmental




# you may be paying for it a second time!

Are you operating a boiler that was designed in the day when fuel costs were much lower? Just since World War II, fuel prices have soared. And these higher costs put a premium on "little" inefficiencies that might have been ignored when your boiler was built.

Conversion is not the answer. You cannot buy efficiency in a boiler designed for solid fuels simply by switching to a conversion-type oil or gas burner. The answer is a *truly* packaged Cleaver-Brooks boiler — with all components designed to work together — fully factory-assembled and fire-tested.

To further provide and maintain top efficiency, modern Cleaver-Brooks packaged boilers offer a combination of fuel-saving design standards that cannot be found in any other boiler — at any price.

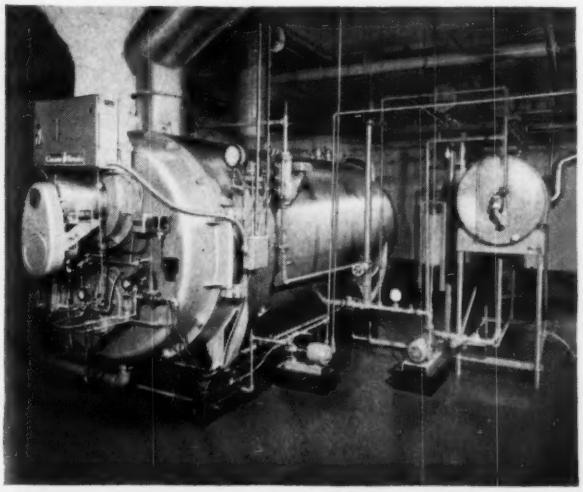
This combination of features — *four-pass design, forced-draft combustion, updraft construction and all the advantages of five square feet of heat-transfer surface per boiler horsepower* — puts your fuel costs down where they belong.

All this is provided by Cleaver-Brooks in the most compact, automatic packaged unit on the market. Sizes through 600 hp . . . oil, gas and combination oil-gas firing . . . larger sizes in Cleaver-Brooks Springfield water-tube boilers. *All* models are expertly started for you by a trained field engineer.

See your local Cleaver-Brooks agent for more detailed information, or write for the booklet, *How to Select a Boiler.*

### GETTING MORE HEAT FOR THE FUEL DOLLAR

The W. T. Rawleigh Company, manufacturer of toiletries, medicines and food products for the home and farm, replaced two old firebox boilers in their Memphis, Tennessee, branch with one fully automatic, combination-fired CB boiler. Mr. James Trindle, office manager, reports: "Our records show . . . 36.4% less fuel consumed during winter months that averaged about 12% colder than the previous year. We're getting greater fuel economy than we expected."



Cleaver Brooks®

ORIGINATOR AND LARGEST PRODUCER OF PACKAGED BOILERS

CLEAVER-BROOKS COMPANY

Dept. G, 301 E. Keefe Ave., Milwaukee 12, Wisconsin

For more facts circle 329 on Reader Service card, p 121

Ask the thousands of engineers who use CHESTERTON STEAM PACKING "64"

and they'll tell you...

1 "64" gives three to five times longer service because of its patented diagonal construction which permits many more "take ups" as it wears.

2 "64" stays resilient where other steam packings grow hard (because of "64"'s special heat resisting compound).

3 "64" costs less because it weighs 20% less and gives more feet to the pound (due to lighter weight of "64"'s non-vulcanizing compound).

WHICH MAKES SENSE TO YOU?

THIS:

OLD FASHION RUBBER BACK WHICH BURNS OUT

1. Has parallel plies of Asbestos which do not respond to gland or service pressure.
2. Requires a rubber back for expansion which fails on high heat.
3. Packing grows rock hard in service because of rubber cement between laminations

CONVENTIONAL PACKING HARDENS!

OR THIS:

NO WEAK RUBBER BACK

"64"

1. Has diagonal rather than parallel ply construction for self sealing action.
2. Remains soft and pliable in service because laminating compound resists hardening.
3. Old fashioned rubber back eliminated by giving expansion through patented diagonal design.

CHESTERTON "64" STAYS SOFT AND PLIABLE!

PACKING Chesterton SERVICE

You can purchase Chesterton "64" from any one of 500 local distributors. Write for catalogue and name of nearest Chesterton distributor.

America's Oldest Manufacturer of Mechanical Packings

A. W. CHESTERTON CO., 7 ASHLAND ST., EVERETT 49, MASS.


## Appointments

Begins on page 194

agencies, the Forum aims to further atomic-energy developments and commercial applications.

Weaver directed the Forum from 1955 and has been chairman of its budget and finance committee for the past two years. He joined Westinghouse in 1936 after receiving an electrical-enginering degree from the University of Pennsylvania. In 1948 he became the first manager of the Company's atomic-power division. He's now in charge of all atomic-power activities for Westinghouse.

### Dr T Keith Glennan

**The Cleveland Electric Illuminating Company** has announced the election of Dr T Keith Glennan, President of Case Institute of Technology, to its Board of Directors. Dr Glennan had served previously on the board but resigned to join the Atomic Energy Commission and later to become the first administrator of the National Aeronautics and Space Administration.

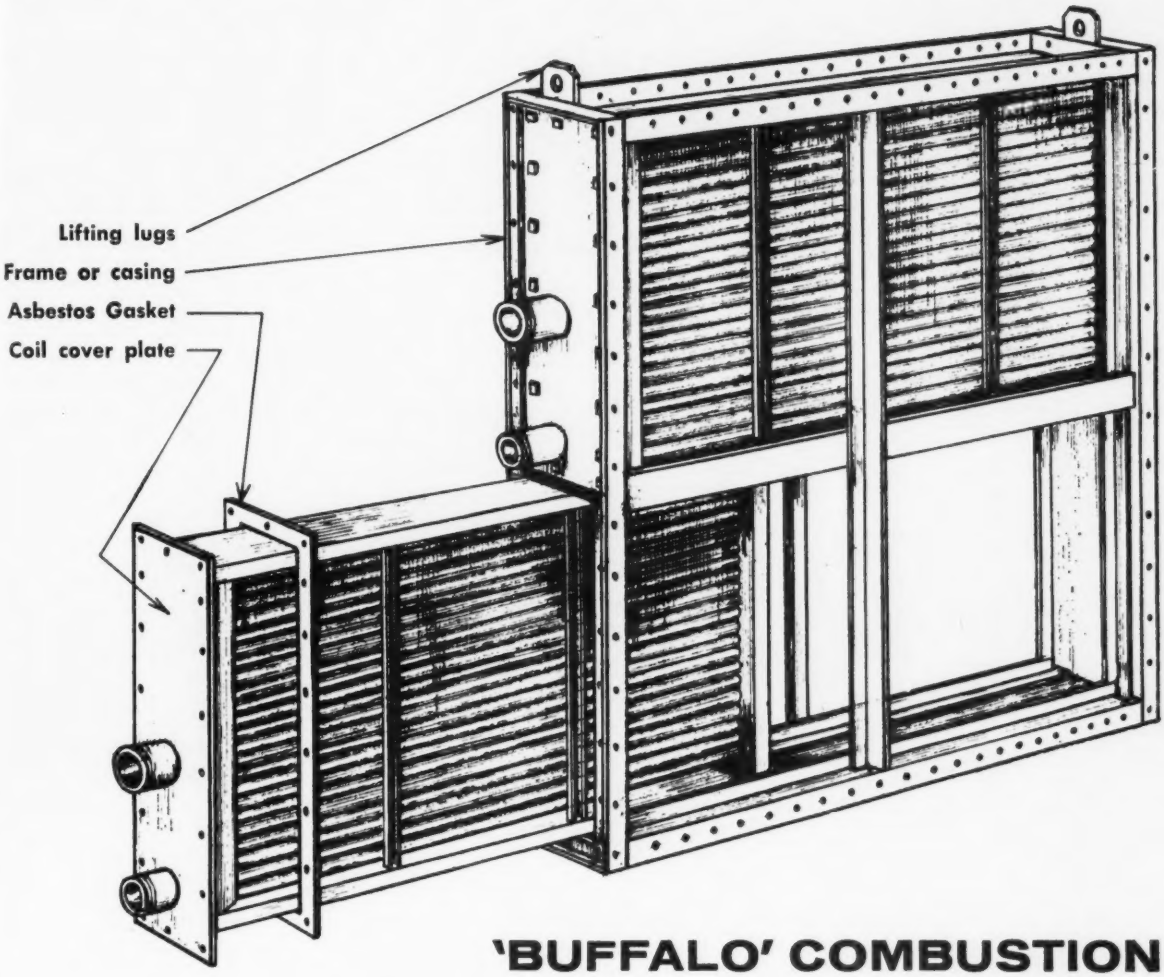
## Purchases & mergers

**Kraloy-Chemtrol Co:** new name of merged Kraloy Plastic Pipe Co and Chemtrol Co. **Koppers Co, Inc** acquires Thomas Flexible Coupling Co. **Leeds & Northrup Co** acquires all outstanding shares of Integra, Leeds & Northrup Ltd.

**Filtors, Inc** purchases Seal-A-Metic Co. **Atlas Copco, Inc:** new name of merged Atlas Copco Eastern and Pacific. **Westinghouse Electric Corp:** small steam and gas turbine dept formed by merger of small steam turbine and industrial gas turbine depts. **Tenney Engineering, Inc:** contracted to acquire Harvick Mfg Corp and Harvick Machine Corp.

## New names

**Cerro Corp:** new name for Cerro de Pasco Corp. **Wheelabrator Corp of Canada, Ltd:** successor to Canadian Div of Wheelabrator Corp, Mishawaka, Ind. **Dynel, Inc:** new firm to serve electro-mechanical instrumentation field.




# 'BUFFALO' COMBUSTION AIR HEATER PACKAGES

## *cost less to install and maintain!*

Expensive on-the-job fabrication of coil casing and frame is eliminated when you use factory assembled 'Buffalo' combustion air heater packages. Aerofin heavy-duty steam or hot water heating coils of tapered fin design give maximum heat transfer and low air-side static loss. Heater casing of heavy structural steel prevents binding when coils are removed and inserted. The removable core cover plate, with gasket, is bolted to the casing or frame to provide a gas-tight fit at high static pressures. For low cost, easy maintenance combustion air heaters, contact your resident Buffalo Representative or write for Bulletin FD 800.

"Buffalo"

AIR HANDLING DIVISION

**BUFFALO FORGE COMPANY**

Buffalo, New York

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

*'Buffalo' Air Handling Equipment to move, heat, cool, dehumidify and clean air and other gases.*

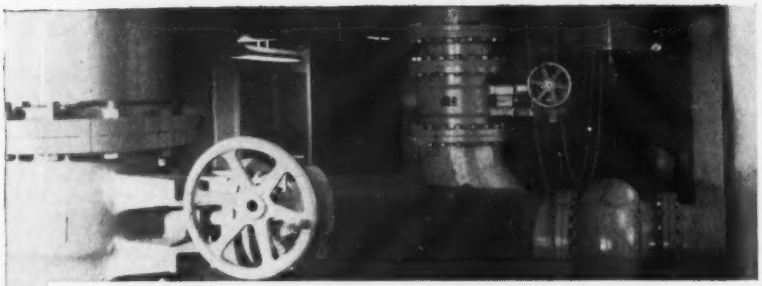
*'Buffalo' Machine Tools to drill, punch, shear, bend, slit, notch and cope for production or plant maintenance.*

*'Buffalo' Centrifugal Pumps to handle most liquids and slurries under a variety of conditions.*

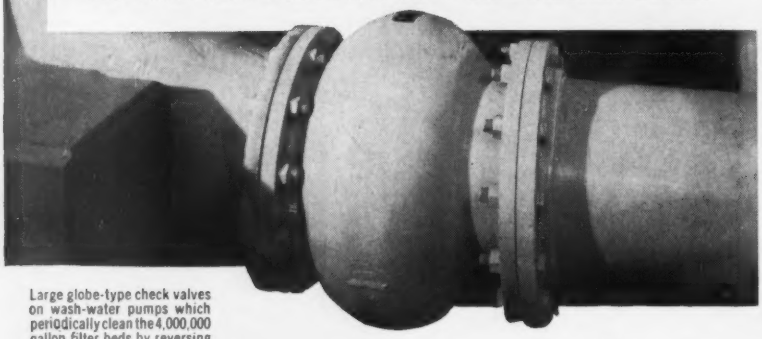
*Squier Machinery to process sugar cane, coffee and rice. Special processing machinery for chemicals.*



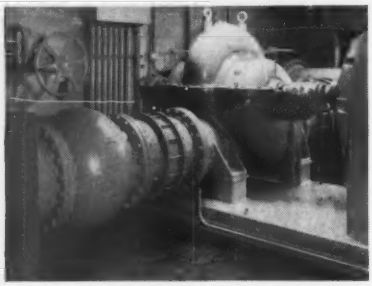
For more facts circle 331 on Reader Service card, p 121



SAFEGUARDING
100 MILLION GALLONS OF PURE WATER DAILY



Large globe-type check valves on wash-water pumps which periodically clean the 4,000,000 gallon filter beds by reversing water flow.

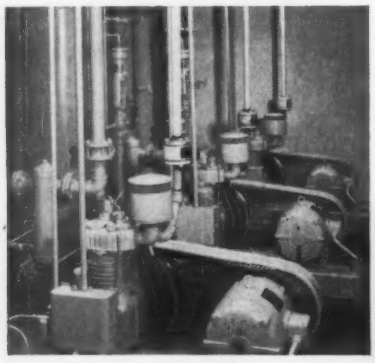


A 24" valve protects pump which conveys purified water to conduit and on to district residents.

Williams-Hager Silent Check Valves are safeguarding the pumps and piping systems of the Water Treatment Plant serving the Metropolitan Water District of Salt Lake. By closing instantly when flow reversal starts or when flow is zero, these check valves eliminate dangerous pressure surges and resultant water hammer damage to the treating systems.

*Write for Bulletins:* No. 851 on Cause, Effect and Control of Water Hammer; No. 659 on Pressure Loss Tests; and No. 654 on Valves.

**The Williams Gauge Company, Inc.**
160 Stanwix Street • 2 Gateway Center
Pittsburgh 22, Pa.
*Our 75th Year • 1886-1961*



1½" silent check valves installed on air compressors supply air for the plant's many pneumatic controls.

WILLIAMS • HAGER
Silent
Check Valves

Five smaller check valves guard pumps furnishing water for cleaning the plant and filter surface wash.


# Bookshelf

**Heat Transfer—Vol II.** *By M Jakob (deceased) Research Professor of Mechanical Engineering, Ill. Inst of Technology. 652 pp, illust, tables, cloth, $15.00. John Wiley and Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

This second volume deals mainly with selected fields of heat-transfer applications. He also gives a comprehensive analysis and discussion of heat radiation in simply shaped spaces.

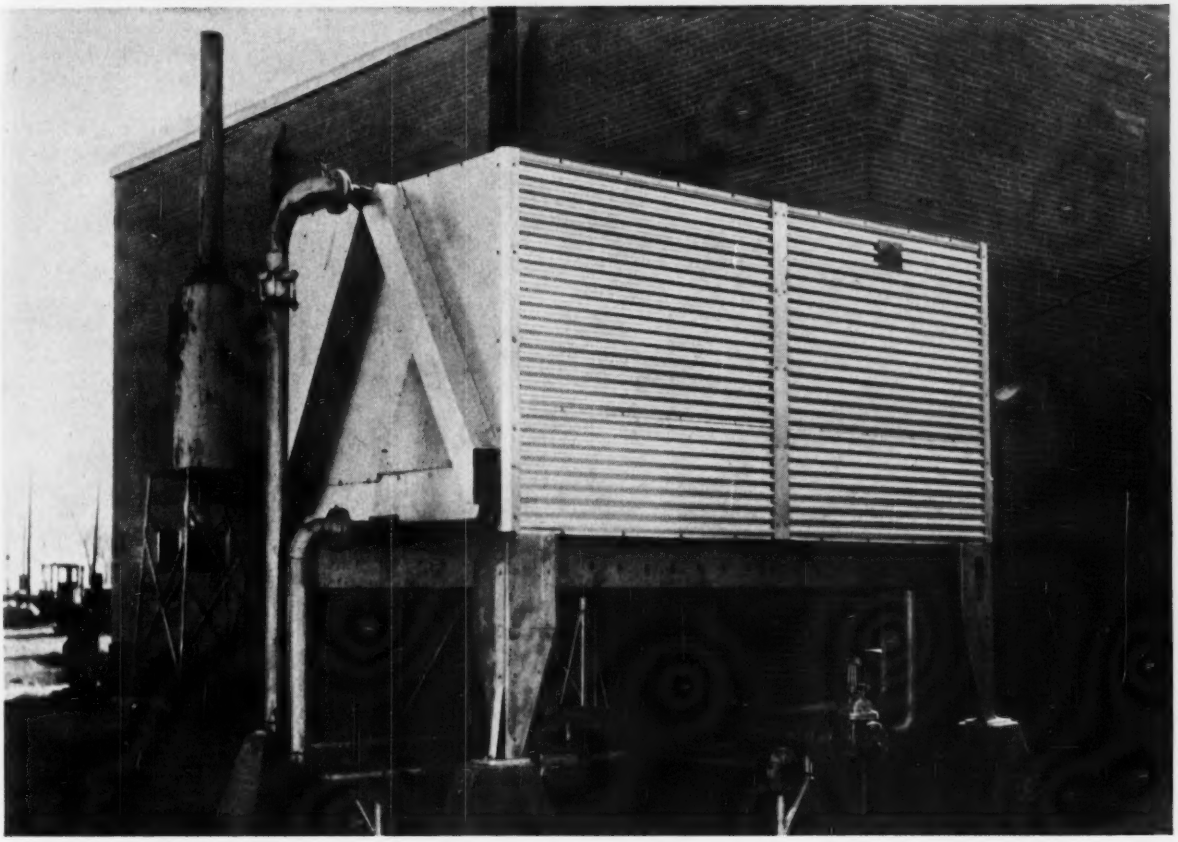
Chapter headings illustrate the scope of the book: (31) heat radiation through a nonabsorbing medium (32) heat radiation through absorbing media (33) heat transfer in thermometry and related branches of measurement (34) ordinary heat exchangers (35) regenerators (36) cooling towers (37) cooling by falling liquid films (38) cooling of surfaces exposed to hot gases (39) heat transfer through laminar boundary layer at high fluid velocity (40) heat transfer through turbulent boundary layer at high fluid velocity (41) heat transfer in liquid metals (42) steady-state transfer in packed columns.

**Principles of Engineering Economy.** *By E L Grant, Professor of Economics of Engineering and W G Ireson, Professor of Industrial Engineering, Stanford University. 574 pp, illust, tables, cloth, $8.00. The Ronald Press Company, 15 E 26th St, New York 10, N. Y.*

This is the completely rewritten fourth edition of this famous book, formerly under the exclusive authorship of Professor Grant. Changes in the new edition include (1) emphasis on concept of cash flow (2) greater stress on capital rationing and using prospective rate of return (3) greater stress on mathematics of compound interest.

(4) Diagrams and symbols have been used to clarify compound interest (5) new interest-series conversion tables have been added (6) new appendix deals with economy studies involving continuous compounding and uniform flow of funds. (7) importance of income-tax considerations are emphasized by earlier treatment (8) influence of writing off cost for tax purposes on after-tax rates

**New Economy**
**New Flexibility** *in Closed Circuit Cooling*



MARLEY

# DriCooler® Fluid Coolers

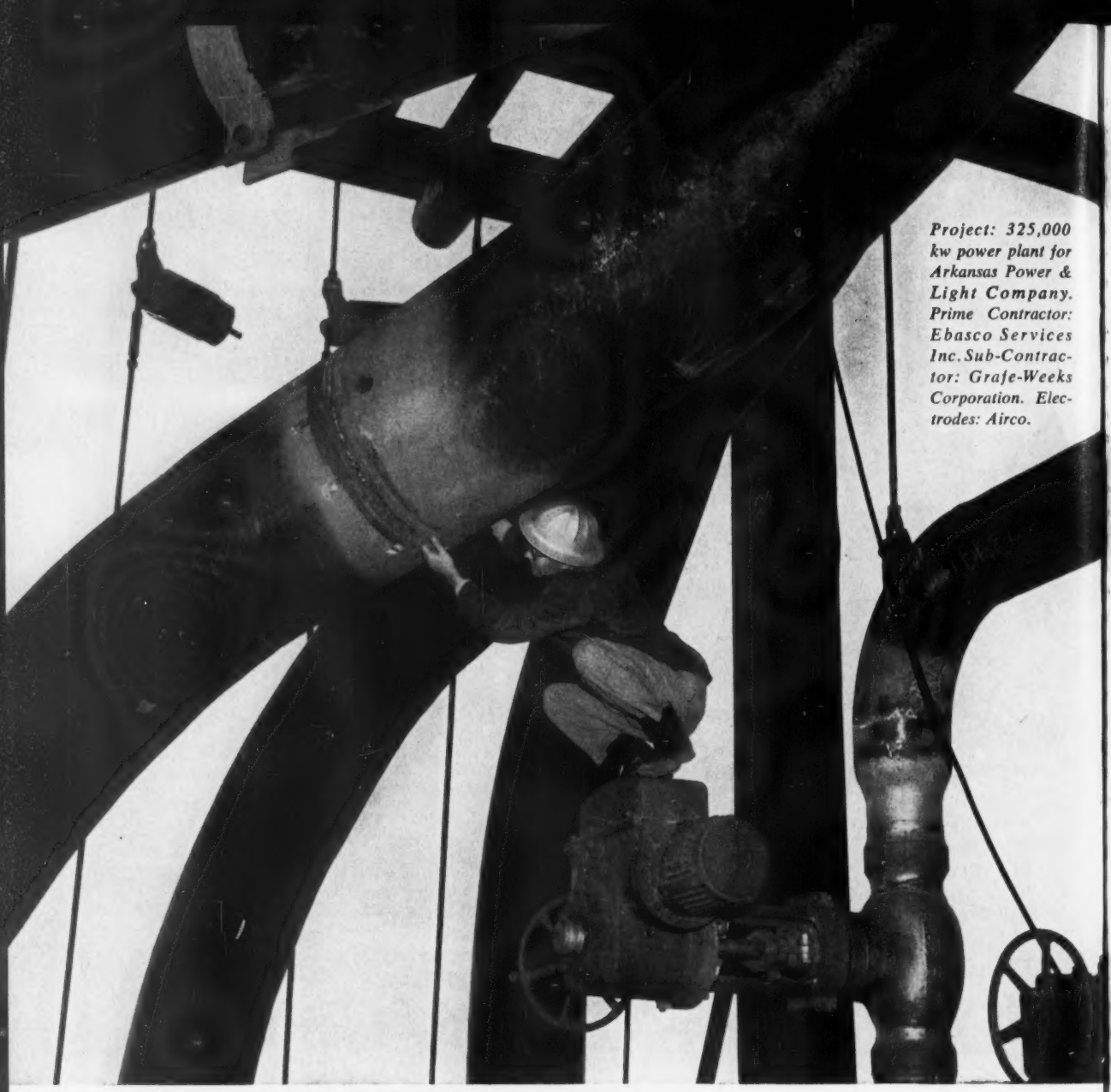
Marley DriCoolers have become the modern approach to closed-circuit cooling of recirculated clean fluids by air . . . because they keep costs and temperatures under *complete control.*

DriCoolers are specifically designed to meet industry's varied needs for high level cooling at low cost. They are engineered to combine a high standard of heat transfer capability with economical use of applied horsepower, long service life and conservative first cost. DriCooler controls provide automatic operation in all seasons, in any climate.

This combination of positive characteristics makes DriCoolers the logical cooling equipment for modern machines and processes — engine jacket water . . . electronic tubes and data processing equipment . . . furnace doors . . . molding and extruding equipment . . . air compressors . . . welding equipment . . . anodyzing tanks . . . quenching baths . . . transformers . . . many process requirements.

For complete details on DriCoolers — or on Marley's complete line of water cooling towers — see your Marley engineer or write direct. You'll find that Marley helps you make the most profitable use of your logical cooling medium, whether it be air or water.

**THE MARLEY COMPANY • KANSAS CITY, MISSOURI**



*Project: 325,000 kw power plant for Arkansas Power & Light Company. Prime Contractor: Ebasco Services Inc. Sub-Contractor: Grafe-Weeks Corporation. Electrodes: Airco.*

# AIRCO LOW HYDROGEN ELECTRODES USED ON HIGH TENSILE PIPE WELDING *at giant new power station*

**AIRCO LOW HYDROGEN ELECTRODES** were used by Grafe-Weeks Corporation to weld the hundreds of feet of high pressure piping in the giant new steam turbine power plant of the Arkansas Power and Light Company at Helena on the Mississippi.

**Why?** . . . Because Airco low hydrogen electrodes provide an easily directed arc specifically designed to meet requirements of high pressure pipe welding . . . They also deliver X-ray quality deposits under tough conditions.

**Ask for a shop demonstration.** Would you like to see Airco electrodes put to the test? Let your Airco salesman or distributor arrange a demonstration at your convenience . . . using Airco low hydrogen electrodes or any other group of Airco electrodes. Call Airco, or look in your Classified Telephone Directory under "Welding Equipment and Supplies" for your nearest Authorized Airco Distributor.

AIRCO

**AIR REDUCTION SALES COMPANY**

**A division of Air Reduction Company, Incorporated**

**150 East 42nd Street, New York 17, N. Y.**

**More than 700 Authorized Airco Distributors Coast to Coast**

**On the west coast—**
Air Reduction Pacific Company
**Internationally—**
Airco Company International
**In Canada—**
Air Reduction Canada Limited
All divisions or subsidiaries of Air Reduction Company, Inc.

For more facts circle 334 on Reader Service card, p 121

Begins on page 200

of return is discussed (9) fallacies of payoff periods and rates of return by original-book or average-book methods are stressed.

(10) Methods for choosing public-works projects are enlarged (11) terms and concepts adopted by research writers have been added.

**The Internal-Combustion Engine in Theory and Practice, Vol 1.** *By C F Taylor, Professor of Automotive Engineering, Mass. Inst of Technology. 574 pp, illust, tables, cloth, $16.00. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

Subtitle of this volume: *Thermodynamics, fluid flow, performance.* For Volume 2 (in preparation) the subtitle is *Fuels, combustion, materials and design.* Book establishes a background for new design, development and evaluation of existing engine performance. Analyses use the characteristics of actual fuel-air media and include convenient methods of comparing actual thermodynamic performance with ideal limits.

Unique features of the book: treatment of 4- and 2-stroke air capacity and engine friction. Throughout, material comes in quantitatively usable and convenient form—tables and charts ready for direct application independent of units of measure or cylinder size. Examples at the end of each chapter show how the material may be used in practical problems.

**Elementary Introduction to Nuclear Reactor Physics.** *By S E Liverhart, Associate Professor of Physics, State University of New York. 447 pp, illust, tables, cloth, $9.75. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

This is a textbook for undergraduate courses in nuclear-reactor physics for advanced students. Aim is to strike a middle course between too-rigorous mathematical treatment and too-descriptive presentation of equipment. Book assumes a knowledge of calculus and differential equations. Scope is indicated by chapter headings: atomic nucleus, nuclear forces and nuclear binding, compound nucleus and nuclear reactions, neutron reactions, nuclear fission, thermal neutrons, nuclear chain reaction, neutron diffusion, critical equation, nonsteady nuclear reactor, conditions affecting reactivity, nuclear radiations and their interactions with matter, radiation detection and measurement, radiation protection and health physics.

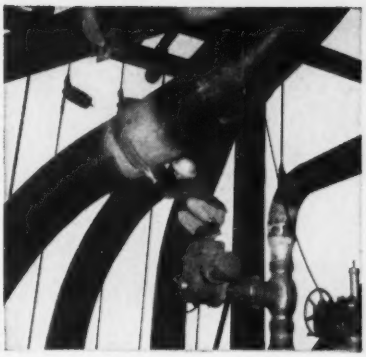
**Thermal Engineering.** *By H L Solberg, Associate Dean of Engineering, O C Cromer, Professor of Mechanical Engineering and A R Spalding, Head of Dept of Freshman Engineering, Purdue University. 649 pp, illust, tables, $9.50. John Wiley & Sons, Inc, 440 Fourth Ave, New York 16, N. Y.*

A revision and extension of *Elementary Heat Power,* book is a first introduction for engineering students to the elements of power and refrigeration machinery. The First Law is the theme of the book. Material balance is applied to the combustion process and to the flow of fluids. A new chapter introduces principles of heat transfer and its application to equipment. Book also deals in an elementary way with atomic fuels.

Major types of prime movers, heat exchangers, turbines, pumps, fans, refrigerators and other apparatus are introduced. Exercises illustrate the application of the principles of energy balance, heat transfer and combustion.

**Mechanical Vibrations.** *By B Morrill, Associate Professor of Mechanical Engineering, Swarthmore College. 262 pp, 196 illust, tables, cloth, $6.50. The Ronald Press Company 15 E 26th Street, New York 10, N. Y.*

Assuming reader's adequate grounding in integral calculus, book introduces solution of second-order linear differential equations, then partial derivatives to the extent that the Lagrange equations can be developed. Solutions of partial differential equations are presented by the separation-of-variables methods, so student can work with problems of mechanical vibrations in a continuous medium. Final section gives background—analogy, the mobility method and applications of the analog computer.

**For your low hydrogen welding— Airco electrodes meet every critical need**

Here are the Airco low hydrogen headliners — from a total of more than 100 Airco electrode types in more than 400 sizes and designs —

**AIRCO 312** AWS-ASTM E60-7016. For welding higher strength alloy or carbon steels. Also high sulfur content steels. Designed to overcome "underbead cracking." Lessens need for high preheat or stress-relieving postheat.

**AIRCO 396** AWS-ASTM E8016-C1. For welding the 2½% to 3½% nickel steels used in low temperature jobs. Also for nickel bearing steels, to provide uniform chemistry at joints with minimum difficulty. No high preheat needed.

**AIRCO 395** AWS-ASTM E8016-C3, A 1% nickel type of low hydrogen electrode. Also for nickel bearing steels where good low temperature properties can be attained; high sulfur content steels; grade HT and similar high tensiles.

**AIRCO 394** AWS-ASTM E10016-D2. For welding manganese-molybdenum high strength steels such as A-302 Grade B.

**AIRCO 354** AWS-ASTM E8016-B2. For welding 1% chrome 5% molybdenum steels used for pressure vessels in high temperature service; and for castings of similar analysis.

**NOW** — "Barrier Carton" bars moisture damage. Special aluminum foil interlining in new carton now protects dryness of Airco low hydrogen electrodes *8 times better than regular style carton.* If your application can't tolerate moisture damage...specify Airco.

AIRCO

**AIR REDUCTION SALES COMPANY**

A division of Air Reduction Company, Incorporated
150 East 42nd Street • New York 17, N. Y.

# LET'S KEEP

# Business Help For Our Colleges Going Full Speed Ahead

"Should our company fold up its program of financial help for higher education now that the Kennedy Administration plans to have the federal government provide this kind of help in a big way?" It is clear why, in the light of campaign promises and plans announced since, this question is being raised in many business firms at this juncture.

What seems far clearer, however, is the right answer to the question. It is a resounding NO! **This is no time for the business community to ease up in what have been its notably successful efforts to help our colleges and universities get out of the deep financial hole in which they are operating. On the contrary, this is the time to put more steam than ever behind the drive of business to increase its financial help for higher education.**

## Massive Help Needed

It is easy to understand why any individual businessman or firm might have a rather despairing feeling about the prospect of competing with the federal government, with its almost all-embracing tax arm, in providing financial support for higher education or almost anything else for that matter. But this is not a case of competition. It is a case where our colleges and universities must have massive help all along the line if they are to be put squarely back on their feet financially—a goal of crucial and perhaps decisive national importance. **The business community will continue to have both the opportunity and the obligation to keep on increasing its help for higher education as rapidly as possible.**

**To underline this proposition take a look at the chart at the top of the next page.** It shows how far the salaries of college and university faculty members continue to lag behind those of other occupational groups in the U.S.A. There has been some relative improvement in the average of faculty salaries in recent years. And the salary improvement in some fields, such as those of science and mathematics, has been very pronounced. But the chart makes clear how badly the average salary of college and university faculty members still lags.

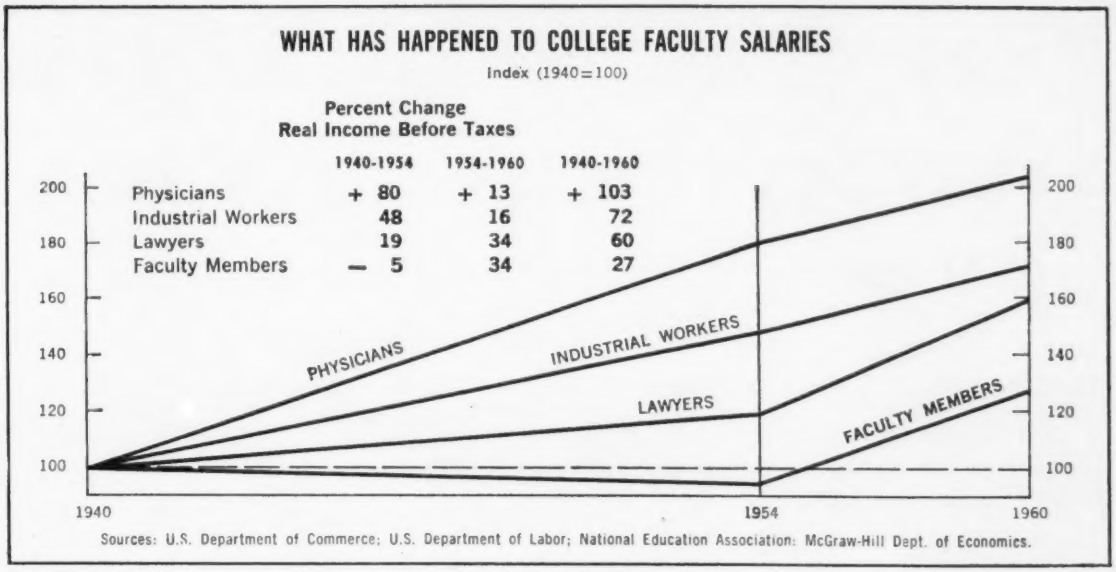
## No Federal Funds For Salaries

The plans for increased financial aid for higher education, proposed by President Kennedy, do not contemplate increased expenditure for faculty salaries. This, we believe, is wise whether or not you feel, as many do, that resort to this kind of federal financing would inevitably carry with it federal controls that would ultimately undermine academic independence. The fight over federal appropriations for faculty salaries would be so long and bitter that it would be destructive to the aid program as a whole.

However, what the federal government will not be doing to remedy the deplorable condition of faculty salaries, as reported by the chart, is one indication of the tremendous scope that remains for crucially important help for higher education from business. Manifold other indications are available.

## Disaster Escape Route

One of these indications is provided by the careful calculation that the annual income of our colleges and universities must be increased by about $4½ billion (from about $4½ billion to about $9 billion) over the next eight years if the tremendous wave of students




now gathering to descend on these institutions is not to wind up in both a financial and an educational disaster. This wave promises to add more than 2.5 million, or 75%, to college enrollments by 1970.

Thus far, the program for financial help for higher education by business, spearheaded by the Council for Financial Aid to Education, has been a remarkable success in all dimensions. The dollars contributed have increased rapidly—from about $100 million five years ago to about $150 million this year. Contributions of $500 million a year by 1970 are a clear possibility.

One of the inspiring developments increasing this possibility stems out of Cleveland, Ohio. There through their chief executives, an imposing group of business firms have established one per cent of their profits before taxes as their minimum goal for contributions to higher education, to be reached within three years. General acceptance of this goal by business would go most of the way toward getting our colleges and universities firmly on their feet financially.

## Mutual Respect Increased

**The mutual esteem of the academic community and the business community, an element of enormous importance to a free society, has been increased by the manner in which the program of financial aid has been carried out.** In making its contribution, there has been no attempt whatsoever on the part of business to encroach upon the academic freedom of the institutions financially benefited. And the program of financial aid has greatly increased the knowledge, understanding and respect which the colleges and universities and business have for each other.

The Kennedy Administration's program to enlarge federal financial support of higher education is certain to arouse strenuous controversy. As proposed by its Task Force, it avoids some of the most controverial areas of principle. However, the very magnitude of the proposed extension of the federal government's already vast program of financing higher education involves fighting issues.

**But if the enlargement of federal aid were to be deeply discouraging to the continued expansion of private aid for higher education, it would be a national misfortune of major proportions. There is no good reason why it should be. On the contrary, there is compelling reason for the business community to continue giving higher education all the financial help it possibly can, thus speeding onward a program that has been and continues to be a major constructive force for our colleges and universities, for business and for the nation.**

This message was prepared by my staff associates as part of our company-wide effort to report on major new developments in American business and industry. Permission is freely extended to newspapers, groups or individuals to quote or reprint all or part of the text.

Donald C. McGraw

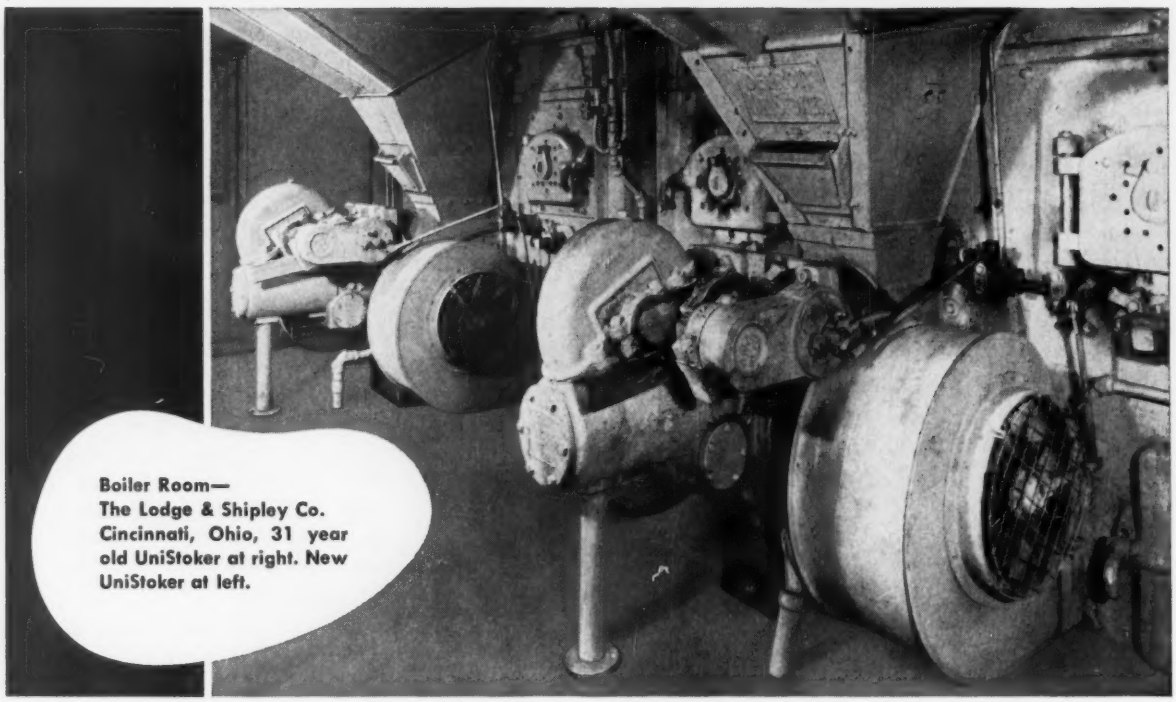
PRESIDENT

McGRAW-HILL PUBLISHING COMPANY

UNI-STOKERS NEVER DIE, NEVER DIE

THEY JUST GO ON... AND ON*

# 31 Year old Detroit UniStoker is still serving and saving



Boiler Room—
The Lodge & Shipley Co.
Cincinnati, Ohio, 31 year old UniStoker at right. New UniStoker at left.

● A Detroit UniStoker installed at The Lodge & Shipley Co., Cincinnati in 1927 performed so well and proved the economy of UniStoker firing so conclusively that another UniStoker was purchased in 1958 when added steam capacity was needed to serve plant expansion.

EVEN MORE SIGNIFICANT—the original UniStoker after 31 years of service was doing such a good job it was deemed worthy of modernization.

Some of the up-to-date UniStoker features were added to it and many more years of efficient operation are expected.

As the song says—"They just go on and on", saving as they go.

YOU can save with Detroit Stokers. Let one of our sales Engineers recommend the correct stoker for your needs.

The Complete Detroit Line of Underfeed and Overthrow Spreader Stokers provides a type and size for almost any boiler from 3,000 to 400,000 pounds of steam per hour capacity.

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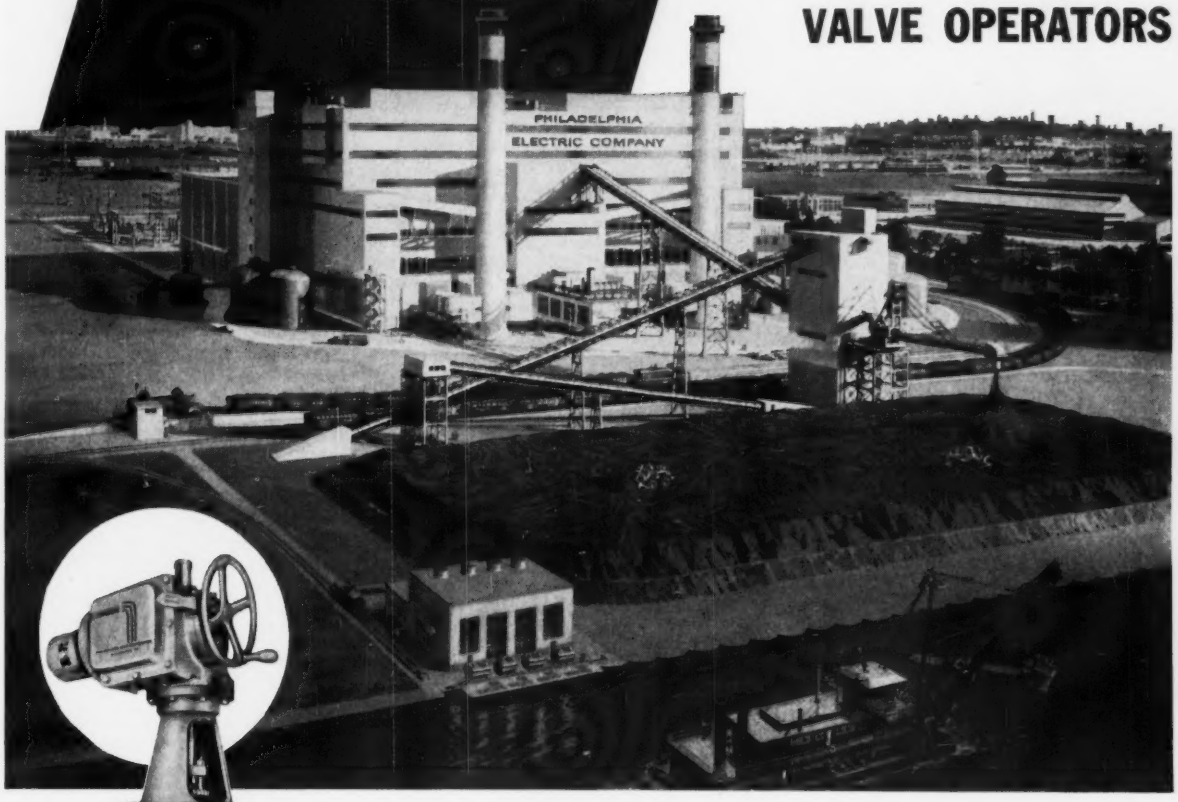
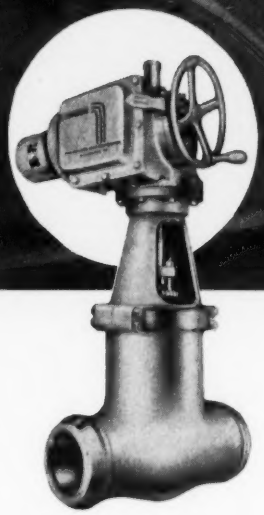
# New Eddystone Station of PHILADELPHIA ELECTRIC CO.....uses LimiTorque VALVE OPERATORS



This Generating Station is one of the World's most efficient power plants . . . consisting of two 325,000 K.W. Super-critical Pressure Units.

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**Lower labor costs of installation.** "K&M" ZEBRA Pipe Insulation, made in half-sections thru 24" pipe size, goes on fast. Reduces number of joints. Its smooth, practically dust-free surface won't penetrate skin, or cause irritations.

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## 5

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**"K&M" ZEBRA®** Pipe Insulation aids you in the fight against the cost-price squeeze and downward-spiraling profit margins. "K&M" offers you a complete line of quality asbestos insulations . . . blocks, spray-type materials, and cements . . . plus high-grade asbestos textiles.

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For more facts circle 339 on Reader Service card, p 121

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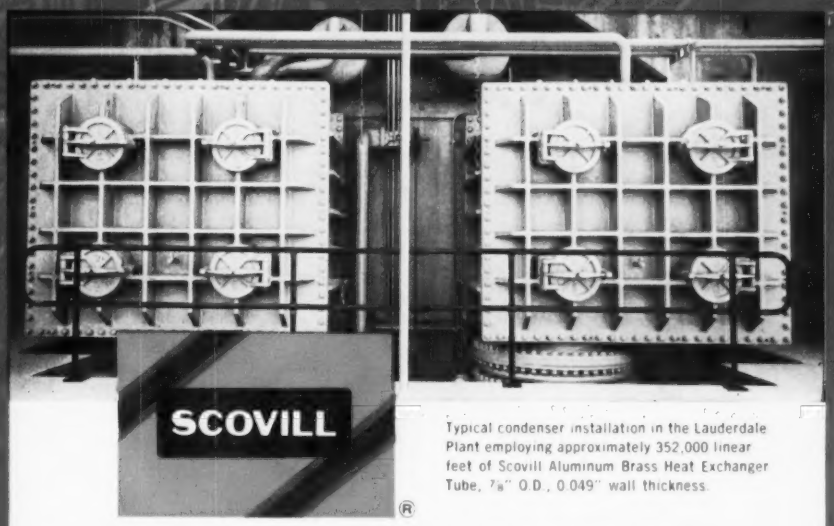
where trouble-free performance is a matter of pride...

FLORIDA POWER & LIGHT COMPANY

Lauderdale Plant




Typical condenser installation in the Lauderdale Plant employing approximately 352,000 linear feet of Scovill Aluminum Brass Heat Exchanger Tube, ⅞" O.D., 0.049" wall thickness.

**HEAT EXCHANGER TUBE** for Applications from Marine to Petrochemical, from Compressor Intercoolers to "Cat-Cracker" Exchangers, in these popular Alloys ... Phosphorized Admiralty • Admiralty • Arsenical Admiralty • Red Brass, 85% • Deoxidized Copper • Arsenical Copper • Cupro-Nickel, 10%-20%-30% • Aluminum Brass • Aluminum Bronze, 5% • Muntz Metal • Duplex Tube

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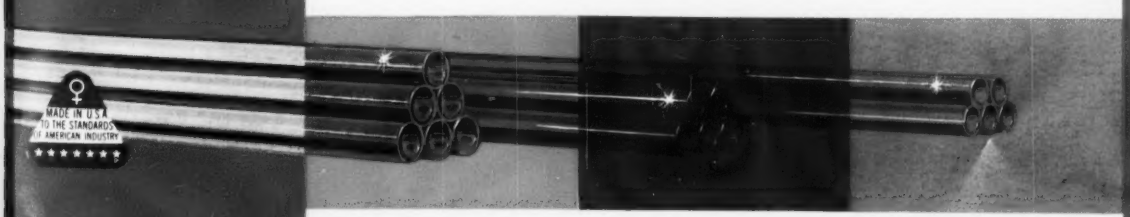
Aluminum Brass is a Scovill alloy that has proved to be highly resistant to corrosion by salt and brackish waters and to the combined effects of corrosion and erosion in salt water service. These good qualities are due to the special nature of the thin, adherent, continuous and self-renewing film which develops on the surfaces of this alloy in service. It is being extensively used in marine and tidewater condenser installations.

Your own condenser and heat exchanger service conditions may be similar or they may be entirely different and perhaps better served by one of Scovill's eleven other popular Tube Alloys. Scovill Technical Service, considered by many the most experienced in the field, can help you make the right selection for trouble-free operation.




**SCOVILL MANUFACTURING COMPANY**

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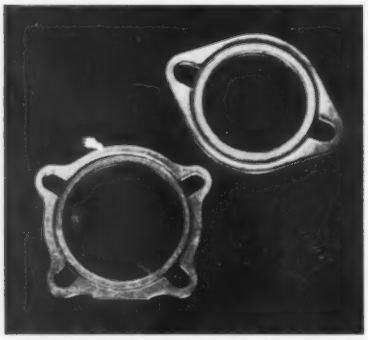
# "Spring Action" gives you a leakproof seal with J-M SPIROTALLIC® GASKETS

Johns-Manville makes a specialty of building a lively "spring action" into Spirotallic Gaskets. Because of their superior resiliency, Spirotallic Gaskets can compensate for varying stresses and temperature changes ... follow minor flange separation ... and absorb vibration. Even under these difficult circumstances, they keep a tight, durable seal.



*Examples of wide range of styles available*

This quick adaptability has given Spirotallic Gaskets a tremendous popularity in the field. Their springiness is due to the special methods and control J-M uses in their manufacture. Spring-like metal strips, formed into a special vee shape, are alternately spiral-wound with an asbestos filler. The filler does the sealing . . . and the vee shape provides the "spring."

Another reason for the widespread acceptance of Spirotallic Gaskets is the fact that when the gasket has been compressed the proper amount, it reaches optimum performance for the bolting. Many different metals and fillers can be used. Each metal is color-coded to aid maintenance personnel in quick identification of the type of metal used.

J-M produces a wide variety of sizes and shapes for standard flanges. And for special flanges, J-M will design and produce a gasket with the precise characteristics you require. For complete information, ask for J-M catalog PK-35A. Write to Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.

JOHNS-MANVILLE

STEVE ELONKA
Associate Editor in Charge

**Expert* answers to your questions on . . .**

# Packing and gaskets

"What packing and gasket questions are most often asked by plant-engineering personnel at the many technical sessions you attend around the country?" Steve Elonka of POWER asked me that recently, and because time and again these questions follow a basic pattern, I'll try to answer them here. No doubt the same questions have bothered many of you readers.

One thing we'll have to do is watch out not to get carried away by specific details. Pressure, leakage, lube, high speeds are all interesting when they're listed and discussed as individual problems. But before we can write good specs or maintain packing and gasketing properly, we'll have to balance out all the complex variables. It's the overall situation that counts.

Usually the questions I'm asked and answers I give run something like this:

**Q—What thought should I give to pressure when I'm considering packing for a centrifugal pump?**

**A**—Pressure is possible in almost any magnitude, or as a variable that we call pressure pulsation. But to clearly define the importance of pressure and understand just how it affects our problem, let's take a simple centrifugal pump for an example. Let's say it's rated 250 psi. The point we have to remember is that 250 psi is the rating of the *discharge* side—which has very little to do with the shaft packing. While the discharge side is under pressure, we're more concerned with the suction side which, even in today's high-pressure high-speed boiler-feed pumps, may be working under vacuum. In this kind of pump, we're trying to pack a vacuum without any lubrication from the fluid being pumped. The answer would be using a lantern ring, or "bleeding back" from the pressure side of the pump.

continued

By *GUY E HORVATH
Marketing Manager
Mechanical Packing Div
Raybestos-Manhattan, Inc

## Knowing the right answers can avoid

**Q—Does pressure affect gaskets?**
**A**—We have very little trouble that way; today's gasketing materials can contain just about all pressures involved. But keep in mind that flange or joint design is the key. Poor flange conditions due to warpage, incorrect design or improper bolt tightening are *deficiencies*. Don't assume that they can be overcome by changing gasket types or thicknesses—go to the root of the trouble.

**Q—How important is gasketing material to the final temperature of a system?**
**A**—Temperature is an item which we can easily measure. Materials are graded for certain temperature ranges and rated for certain jobs—it's obvious that asbestos and rubber will have different specifications. But the packing specialist often recommends a material for temperatures that seem far beyond its strength. He does this because he knows that some decomposition at high temperatures is not necessarily fatal—the products of decomposition may even play an important role in the gasket.

For example, many rubber gaskets are combined with products such as asbestos and the combination handles far above what rubber alone will stand. Take compressed asbestos sheet where the prime gasketing material, the asbestos fiber, is bonded with an elastomer. Your expert knows that the rubber is only a binder, a means of manufacturing the actual gasket. There's so little elastomer that when it decomposes and is confined between metal surfaces under pressure we still have a very adequate gasket.

We must also be aware that temperatures in a pipe or a pump may be somewhat lower in the gasketing or packing areas—sometimes as much as 25% below that of liquid or gas handled. This is good since the actual temperature of the fluid could completely decompose a packing or gasket.

**Q—Do engineers give enough attention to how the sealing material affects the medium being sealed?**
**A**—No! Since all liquids and gases handled must be packed or contained or stored in some manner, every aspect of the packing materials must be considered. We must also think in terms of the fluid or combination of fluids we're working with. I find that it's common for packing-recommendation requests to make a great point, for example, of the fact that an acid problem exists. Yet they may not even mention that the acid content of the fluid is only 2 or 3%. So the expert devotes his time and thought to the acid side of the case. He's left completely unaware that a solvent is present in a much higher percentage and is really the tough part of the problem.

Not only should we consider the content of a fluid or combination, but we must know what happens during leakage. Of course we know that the fluid is supposed to leak a little to lubricate its packing. But during the process, a leaking liquid often evaporates as it flows to atmosphere. And if evaporation leaves a residue of crystals in the packing, we have a really difficult problem. Yet this abrasion factor is often overlooked when we consider packing. Here again, a lantern ring with a 5- to 10-psi pressure increase will help cancel the abrasion.

**Q—How does fluid leakage affect packing?**
**A**—A fluid film between packing and moving shaft is a must if any packing is to give good service. If we depend on lubrication from the fluid being contained, we'll have many points to consider. Some fluids will be good lubes and some won't. But in any case, pumpage of vacuum pumps and gas pumps or compressors will have no inherent lubrication. In these cases lube will have to be applied from an outside source or from the packing itself.

In this area, Teflon has provided our greatest advance among packing materials. Teflon and graphite are both considered solid lubricants, but Teflon is more versatile and more efficient.

Any packing problem brings up two important considerations. What is available to act as a lubricant? How can it be maintained? Lubrication in a packing is just as important as it is in a bearing.

**Q—How do you pack against high shaft speeds?**
**A**—Shafts and plungers can move slowly or fast. In a reciprocating plunger, rubbing speeds of over 250 fpm are critical and they're often tough to pack properly. Length of stroke also is important, because high pressure, high speed and short stroke give you friction, and heat builds up rapidly. This heat can't be carried away if strokes are short. So localized heating occurs quickly and scorches the wearing surface of a packing.

With rotating shafts, it isn't rpm alone that counts. Product of rpm and shaft circumference establishes rubbing speed. While the ranges aren't as critical as they are in reciprocating equipment, certain types of packing are very poor performers at rubbing speeds over 2500 fpm. Below this range, many types are OK.

Leakage rates are also important, to provide adequate cooling fluid for high speeds. A rotating piece of equipment tracks the packing in the same spot. The reciprocating pump continually makes new surface contact with the packing. For this reason molded V-type packing doesn't properly seal rotary shafts, though it's ideal for reciprocating motion.

**Q—How does clearance around a packing affect its life?**
**A**—Clearances designed into a piece of equipment are enlarged by wear and misalignment—packing life drops as clearances increase. Clearance problems are compounded by a shifting shaft or a gland follower. Annular clearance might be only 0.010 in., but it takes just a slight shift to compound this clearance to 0.020 in. because of misalignment or wear.

Misalignment, called "postholing," kills your packings. Misaligned or off-center shafting will posthole packing by beating it back. Soon leakage becomes excessive and packing life shortens.

An off-center shaft will also become a wobble pump as it postholes through the packing. With each revolution, the

fluids being sealed will flood the clearances. Then as the shaft rotates it pushes fluids toward the low-pressure side.

**Q—Is there any relationship between packing life and plant personnel?**
A—Yes! Packing life depends a lot on maintenance habits and procedures followed and these in turn depend on plant personnel. That's why a change of personnel may reduce the life of a packing, shaft, or plunger.

**Q—Does better surface finish of machined elements have much effect on packing life?**
A—You'll have to think in terms of the type of finish you want, and the type you can tolerate costwise. Although a fine finish is always desirable, its profile is often a greater consideration than its finesse. A sharp saw-tooth profile, even in the better finishes, can file down the packing.

A so-called "rough" finish which has been touched with abrasive cloth to knock off the sharp edges can be ideal. I have seen reciprocating plungers with grooves as deep as 1/32 in. worn into the plunger. Yet if alignment and clearances are OK the plunger doesn't leak badly.

**Q—How does stuffing-box depth affect sealing efficiency?**
A—Depth of stuffing boxes varies greatly with different types of equipment. Stuffing boxes for centrifugal pumps can vary from 4 rings of packing to as many as 12. Both operate well, but they'll need different adjustment and breaking in.

A stuffing box with many rings has a long throttling effect on the leakage. But if temperature caused by friction expands the packing, that may shut the leakage off quickly. Result is scorched packing and scored shaft. A stuffing box with fewer rings may react the same way because greater adjusting pressures must be placed on the packing. This will limit adjustment, and again you're risking a quick shutoff of leakage. Use five rings of packing with or without a lantern gland.

**Q—How many basic types of packings are there?**
A—Some seven groups or types of materials are used to manufacture packing and gaskets, but they're made into many combinations for varied services. While the types of service can be listed under a very few categories, packing combinations on the market for these services are legion.

**Q—Do organic fibers fill a useful need in packings today?**
A—Organic fibers, flax and cotton, were popular many years ago. They're gradually fading out of the packing picture—especially cotton. The greatest limitation on these two materials is their narrow range of temperature resistance. They were popular mainly because both were easily available and both had great absorbing qualities. So many types of lubricants could be combined with them.

But even when they're used on shafts or plungers where temperature is normally within their operating range, you always run the danger that these temperatures will be exceeded because of friction and high rubbing speeds. We find no logical reason to combine organic fibers with Teflon, because of the temperature factor.

**Q—What are the limitations of inorganic fibers like asbestos and glass?**
A—Asbestos, both the white and blue types, is the most-used material in packing and gaskets. Asbestos is basically a rock. Fortunately it can be processed into usable forms. Because of its great temperature and chemical resistance it's an excellent material for packings and gaskets. But asbestos isn't indestructible and it is affected by various acids to varying degrees.

Heat drives off the water of crystallization, reducing the asbestos to a fine powder with no structural strength. Around 1000 F, asbestos is on its way to decomposition but still functions as a packing material. Asbestos yarns and cloth are reinforced with many types of wire to increase their tensile strength and let them withstand high temperatures and pressures.

Asbestos is very common as a friction material in brake linings and clutch facings. These require opposite frictional characteristics to those needed in packing. Modification for low friction combines asbestos with special materials and lubricants.

Spun into yarns and woven into cloth, asbestos contains varying amounts of cotton depending on service required. Commercial-grade asbestos used in packing contains about 25% cotton.

**Q—Are the elastomers holding their own as a packing or gasket material?**
A—Today the synthetic rubbers are considered much more efficient than natural rubber for packings and gaskets. Natural-rubber compounds have a weakness: at relatively low temperatures the rubber reverts to a soft gooey mass even though it is vulcanized. This causes rapid deterioration of packing and gaskets because the rubber loses its ability to bind—hold together—a packing structure. However, rubber is still a popular gasket-sheet material for low-pressure steam and hot water.

Our synthetic-rubber materials usually don't go through this reversion. Silicone rubbers have the extended physical characteristics needed for higher temperatures. These have brought about a breakthrough, jumping limitations from 275 up to 500 F—a great step for the packing industry.

Rubber and synthetic-rubber materials are either used in sheet form or converted into cement.

**Q—What jobs do the metals—lead, aluminum, brass and others—handle?**
A—Although some packings are made entirely of metals such as lead and aluminum foil, the metals are not universally accepted packing materials. But they are often used together with asbestos. Metals contribute to extrusion resistance and low friction in many packing situations; packings which must perform an auxiliary bearing function are combined with or made wholly of metals.

By R E BOALS, Cleveland Electric Illuminating Co

# Establish limits for pulverizer fineness tests

**Cleveland Electric Illuminating Company ran extensive checks to determine the accuracy of their technique. Here's what they found**

**SAMPLING ACCURACY** of periodic fineness tests for pulverizers depends upon mill variables and basic accuracy of analysis

How accurate is your coal sampling? The answer to that question varies with type of test performed and ultimate use of the sampling results. In the category of pulverized-coal sampling, we recently completed a series of special checks on our operational sampling tests. These are periodic tests of pulverizer performance including fineness samples for each mill. Variations in fineness are interpreted as changes in coal requiring adjustment of the mill, or as indications of mill wear which can be plotted to schedule grinding-element maintenance.

In either case, efficient operation of our plants necessitates accurate coal tests and complete knowledge of our accuracy limits. Special check series supplied this knowledge for our Eastlake Plant. Although the specific results may not apply directly to your plant, our techniques and analysis should supply answers for any other installation.

Our tests were designed to monitor fineness changes caused by four basic factors: (1) repeatability of readings for a given sample with one set of sieves (2) consistency of grinding from one mill (3) change of fineness over a 10-day period with constant coal supply, mill settings and set of screens (4) variations in fineness results caused by discrepancy in different sieves.

**Test results** reported for each of the basic factors are tabulated above, right. Results listed—on the 50-mesh, on the 200-mesh and through the 200-mesh sieves—indicate the variations.

Additional variables were checked out as the tests progressed. On the basis of this additional material, we came to these conclusions:

**Effect of drying samples** before analysis, compared to not drying, proved insignificant since our samples were sealed tightly in rubber-gasketed glass jars until analyzed.

**Length of time** the samples were shaken during analysis was increased in 2-minute increments, showing a gain of approximately 0.05 grams per minute in the through-200-mesh portion of coal samples. Since the ASTM code dictates 0.10 grams per minute as allowable, the 20-minute period we use in our own tests is satisfactory.

**Sampling-rate variations** showed, in our case, the only requirement is that the sampling traverse be made at a constant rate.

**Separate samples** taken from two points, 90-deg apart in one plane, showed definite stratification of coal. Extreme care is required to obtain equal amounts from each point, so a representative composite sample may be analyzed and reported for each mill.

Based on our accumulated data it seems that: (1) The –200-mesh samples are our best guide to classifier adjustment and indication of mill wear. (2) Accuracy of the samples is established within a fairly wide band because the total deviation of mill fineness over a 10-day period was very close to the accuracy limit of the daily milling ($\pm$ 3.9 compared to $\pm$ 3.3%). This means we can take mill samples once every two weeks with satisfactory results. (3) Finally, we revised our report form to recognize the range of values we should expect. Our new reports take the following form:

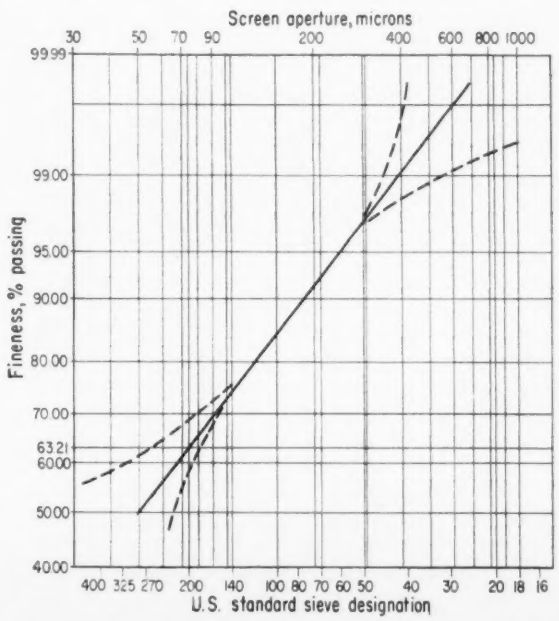
| Mill | + 50 mesh | | + 200 mesh | | – 200 mesh | |
|---|---|---|---|---|---|---|
| | | Range, % | | Range, % | | Range, % |
| 3B | 0.8 | 0.5–1.1 | 23 | 19–27 | 77 | 73–81 |

This same general form would help you analyze and evaluate performance-test data for your pulverizers.

## Check-series results showed effect of operating, sampling variables

| Testing variables | Mesh | Avg test results, % | Range of values | Variation, % |
|---|---|---|---|---|
| Accuracy of analysis, that is, repeatability limits when running two or more analyses from one sample through one set of sieves. The results from 14 sets of duplicate samples were: | + 50 | 1.04 | 0.98– 1.11 | ± 6.7 |
| | + 200 | 23.62 | 23.43–23.82 | ± 0.85 |
| | – 200 | 76.38 | 76.18–76.57 | ± 0.25 |
| Consistency of grinding from a pulverizing mill. This was accomplished by taking samples at approximately 10-minute intervals for about one hour and processing the samples through the same set of sieves used in analysis-accuracy check. The results from six days of sampling were: | + 50 | 1.02 | 8.73– 1.31 | ± 28 |
| | + 200 | 23.70 | 21.21–26.20 | ± 11 |
| | – 200 | 76.29 | 73.80–78.79 | ± 3.3 |
| Change in fineness over a 10-day period with the mill strictly on pipeline coal, at a constant classifier setting (2 2/3) and analyzed on one set of screens was: | + 50 | 1.04 | 0.58– 1.50 | ± 44 |
| | + 200 | 23.52 | 20.53–26.52 | ± 13 |
| | – 200 | 76.47 | 73.48–79.46 | ± 3.9 |
| Variation in fineness readings because of any discrepancy in the four sets of screens normally used during the routine tests. This was pinpointed by dividing each of six samples in quarters and analyzing one quarter in each set of sieves. The results were as follows: | + 50 | 0.82 | 0.73– 0.92 | ± 12 |
| | + 200 | 22.38 | 21.17–23.60 | ± 5.4 |
| | – 200 | 77.61 | 76.40–78.83 | ± 1.6 |
| Overall effect of the four variations above showed us the best limits we could expect from routine analysis. Overall limits are the sum of the effect of the four individual limits. Effective percent variations were: | + 50 | —— | —— | ± 40 |
| | + 200 | —— | —— | ± 16 |
| | – 200 | —— | —— | ± 4.9 |

## Rosin-Rammler chart points out nonrepresentative samples




Coal-sampling technique for mill-fineness determination is an obvious corollary to analysis procedures outlined above. As a starting point we have the ASME Power Test Code for Pulverizers and the ASTM instructions for sampling direct-fired pulverized coal.

Both codes recommend multipoint sampling of coal streams. For initial test work on a given job, this involves traverses on three diameters spaced 60-deg apart or four diameters spaced 45-deg apart. On each diameter, collect samples from concentric rings of equal area. This represents a great deal of testing—certainly too much for periodic tests. So back off on number of diameters and area segments until results are affected.

Rosin and Rammler chart at left may indicate deviations caused by testing procedure. Fineness readings plotted on the chart must lie along a straight line if the sample is representative. Deviations in the 200-mesh range usually are caused by incorrect sampling velocity. Too-low inlet velocities at probe tip permit small particles to dodge the tip. Too-high velocities pull small particles from surrounding coal stream.

The 50-mesh errors often result from coal-stream segregation. If this is acute, move to a better location.

OPERATORS' NOTEBOOK **150**

By STEVE ELONKA, Associate Editor

# Stress bolts right to make up tight flanges

**MANUAL IMPACT WRENCH** builds up spring power; number of blows indicates bolt tension

Today more than ever before, greater speeds, heavier loads, higher temperatures and pressures demand accurate flange tightening. In selecting the best fastener for each unit and specifying torque-wrench settings, designers consider and balance factors such as (1) tension needed to keep bolt tight under maximum stress (2) smallest adequate bolt to reduce weight and cost (3) type of bolt material (4) class and type of thread (5) safe maximum tension and clamping to prevent distortion and breaking.

All this adds up to a truism: after such careful engineering analysis went into selecting the component, it's only good sense to follow proper procedures when tightening the assembly during manufacture or maintenance.

We talked about prestressing bolts in *Operator's Notebook 148*, April 1961. Last month, *No. 149* took us into the subject of bolt stretch. Now, in this final article of the series, we're ready to look at common ways of torquing.

When a flanged joint is assembled, each component comes under varying tensile or compressive stresses. During service, especially at high temperatures, the flanges transmit heat to the stud or bolt, causing it in turn to expand at the rate of its coefficient of linear expansion. But normally this is such an infinitesimal difference that it can only be calculated on paper or measured under laboratory conditions. You can ignore it in the field.

**Initial bolt stresses** for flanged joints must be high enough to insure a tight joint. But at the same time you'll want a reasonable safety factor, to be sure stress doesn't come too close to the yield point of the bolt material. Usual practice in field-erected flanged joints is shown in table at left. According to Crane Co's survey, these initial stresses are customary when alloy-steel bolt-studs are pulled up by hand. Experience has proved these stresses OK for American Standard steel flanges. Values in this table are graduated by size—if you can't apply higher torques, it's best to keep initial bolt stresses at about one-third of the material's yield point.

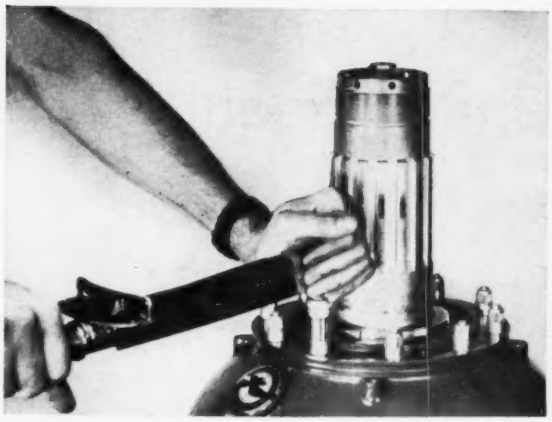
Stress can be applied by one of three methods: (1) figuring proper torque and pulling up the well-lubricated bolt-stud by that amount (2) figuring elongation needed for the desired stress and pulling the bolt to that length (3) prestressing bolt with a pneumatic tensioner. If you're

## Initial stresses for American Standard steel flanges

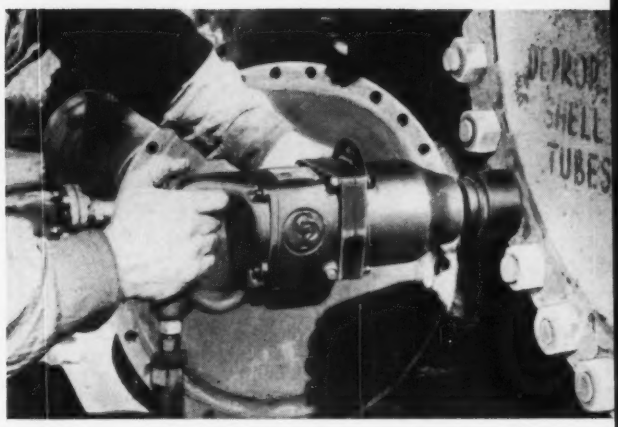
| Size of alloy-steel bolt-stud (note 1) | Average stress applied manually, lb per sq in. (note 2) | Approximate torque to obtain stress, ft-lb (note 3) | Elongation, in. per in. of effective length (note 4) |
|---|---|---|---|
| ¾ | 52,000 | 175 | .00173 |
| ⅞ | 48,000 | 255 | .00160 |
| 1 | 45,000 | 370 | .00150 |
| 1⅛ | 42,500 | 500 | .00142 |
| 1¼ | 40,000 | 665 | .00133 |
| 1⅜ | 38,000 | 860 | .00127 |
| 1½ | 36,500 | 975 | .00122 |
| 1⅝ | 35,000 | 1285 | .00117 |
| 1¾ | 34,000 | 1700 | .00113 |
| 1⅞ | 33,000 | 2200 | .00110 |
| 2 | 32,000 | 2350 | .00107 |

Notes: (1) Coarse-thread series, 1 in. and smaller; 8-pitch-thread series, 1⅛-in. and larger. (2) Average stress applied by maintenance man in assembly, using a lever and wrench or sledging. (3) Based on well-lubricated threads. (4) Based on modulus of elasticity of 30,000,000

Courtesy, Crane Co, Chicago, Ill.



**BEAM TYPE TORQUE WRENCH** flexes as torque increases, changing relationship between the pointer and the dial near the handle



**PNEUMATIC IMPACT WRENCH** has integral torque control. Its setting can be adjusted to any value between 500 and 1000 ft-lb

using the second method, you will need to calculate total elongation of the bolt. Do this by multiplying the value given in the table for elongation (in. per in.) by the effective bolt length (distance from center of nut at one end of the stud to center of nut at the other end).

POWER's 24-p report on *Gaskets*, March 1954, covered effects of gasket flow, bolt pressure and flange-surface finish on sealing action, and the consequences of improperly tightened bolts. In this connection, remember that properly specified new gaskets and flanges *should not leak*. If they do, it's a signal that they were tightened improperly.

**Torque is a twisting,** the effort we apply in turning a nut, bolt or cap screw. It is measured in units such as ft-lb or in.-lb—in other words, length multiplied by weight. Let's say you have a ft-long socket wrench extending horizontally from a nut. If you hang your own 200-lb weight on the wrench's end, you're applying 200 ft-lb or 2400 in.-lb of torque to the nut.

Last month we said a bolt stretches about 0.001-in. per in. of length for each 30,000-psi tensile stress. Torquing is the common way of getting this stretch. How much torque do we need? A torque chart supplied by the wrench or equipment manufacturer—table at left—will give the approximate answer.

**Three basic torquing tools** are the (1) spanner (2) impact wrench (3) torque wrench. Bolts can also be expanded by heat or with tensioners, but in the strict sense neither of these methods is torquing.

(1) Hand-tightening with a spanner or a box, socket or monkey wrench is an old hit-or-miss, unscientific way. But it's still used. To make matters worse, someone is likely to add a long piece of pipe to the wrench for leverage, or try a hammer as a "convincer". Results are overstretched bolts or stripped threads, making the flange assembly useless and sometimes dangerous.

(2) Impact wrenches are pneumatic- or electric-power driven, or spring-actuated. There are many models on the market, each with its own distinct features. Photo, above right, shows a heavy-duty pneumatic-operated impact wrench with integral torque control. This wrench shuts itself off once it has reached the proper torque. Torque setting can be adjusted to any value between 500 and 1000 ft-lb, simply by turning the adjustment screw with an Allen wrench. A lockout button lets tool do the work of conventional impact wrench with full $1\frac{1}{2}$-in. bolt capacity.

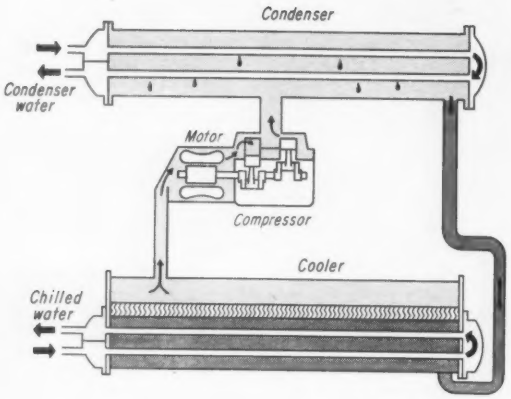
Calibrators are used to determine proper settings for many types of air-pressure-operated and torque-control impact wrenches. They are especially necessary when you're installing high-strength structural bolts. Calibrator gage reads directly in lb of tension. Actual bolts, nuts and washers from the job are tightened in the calibrator —a new set of these should be used each time the wrench is applied. Adjust wrench setting until a series of three bolts can be tightened to more than the needed minimum tension, and no bolts break.

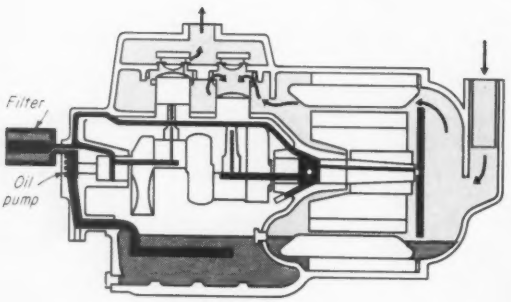
Spring-actuated wrench, photo at left, is self-contained, hand-operated—a rachet type impact wrench. It uses principles of the hammer, lever and spring; automatically delivered rotary hammer blows or impacts produce the torsional force. This wrench will apply brute force to loosen a frozen nut or it can be switched to the precise task of tightening a bolt to desired tension with little manual effort. Torquing is based on the relationship between number of impacts and bolt tension—a click clearly indicates each blow, and mechanic estimates the tension by counting the clicks.

Sensory torque wrench sounds a distinct click, then imparts a strong impulse to the operator's hand the instant a preset torque has been applied to the nut. Operator can also read torque on the dial.

Center photo shows a torque wrench which releases automatically when proper torque is reached. To set it, operator turns the handle until the micrometer adjustment indicates desired torque. Then he locks the handle, attaches the socket, applies his wrench to the nut or bolt and pulls smoothly until the wrench releases.

**Torque readings,** as we pointed out in *Notebook 148*, do not always mean that the load has been placed in the stud. With torquing devices, the true load can only be determined by actually measuring elongation of the bolt in question. You can do this with an extensometer, measuring over the full length of each bolt. Or you can use a measuring device as indicated in *Notebook No. 149*.




## Compressor oil system supplies test point for monitoring cleanup

System cleanup must extend beyond the compressor and motor housing. Entire cycle, shown above, requires a careful flushing with solvent.

Cutaway drawing of compressor indicates access points and areas of contact between oil and contaminated refrigerant. Keep in mind—pH test will only indicate presence of inorganic acids, so it's suitable only for checking efficiency of cleanup after a breakdown. It will not indicate organic acids, soaps, etc found in cases of excessive temperature.

Many solvents on the commercial market today will do an efficient job of cleaning. However, from experience we have found that Refrigerant-11 is quite suitable and does an excellent job. Refrigerant-11 attacks carbon products that hold to the walls of the compressor and refrigerant piping. Small systems are easy to flush, using drum pressure to force refrigerant through. On large systems, use a chemical pump. When flushing the system, collect samples of solvent coming out the open end of the piping. Observation will determine when all residues have been washed free.

Cleanup and checkup procedure is explained at right. It is extremely important that the procedure be followed exactly as listed to get results.

One last warning on general system cleanup: be careful not to get residues on *you!* Hydrochloric- and hydrofluoric-acid burns are difficult wounds to heal.

# Check cleanup after

By E G FREDA, Service Engineer, Carrier Corporation

In fractional-horsepower applications such as home refrigerators and freezers, hermetic compressors proved they could stand up under design loads and were capable of troublefree service. This demonstration, added to other advantages of hermetics, spurred development of the present larger units, both centrifugal and reciprocating. But with all its advantages, the hermetic has one poor feature: this problem of motor burnout. Unfortunately, should the compressor fail because of this feature all its advantages tend to be forgotten.

A hermetic burnout can be expensive if for no other reason than that it shuts down the entire refrigeration system during repairs to the drive section. If repairs involved no more than an exchange compressor or new motor, problem would be small. But a burnout not only destroys the motor, it leaves the entire system contaminated—contamination which must be removed before the system returns to operation. It is not enough merely to change oil once and put in a new motor. A cleaning procedure must be used and a field test applied to indicate its effectiveness. If such a procedure is not followed, expect a second burnout. This article is designed to help you avoid that second burnout.

**Why is it so important** to clean as thoroughly as possible? This can only be realized by analyzing just what contaminants dirty the system. Frequently, burnouts are caused by motors losing one leg of their feed and running single-phase, by a phase-to-phase short because of worn insulation, by prolonged overload operation or mechanical failure. Each failure generates heat in the motor. Its insulation burns and the oil and refrigerant rise to temperatures that cause each to decompose.

Yours would be an unusual system if it were completely free of water, metal oxides, soldering flux, maybe a little air and even free copper or iron chips. Presence of any of these foreign substances will start any one of a number of reactions with the oil or refrigerant to form organic and inorganic acids and soaps. We won't dwell on the chemical reactions that can take place in a refrigerant system, but it's pretty obvious that these substances, plus contaminants produced by decomposition of motor insulation, all add up to one big mess which must be removed before the unit can return to operation.

Cleanup methods are straightforward. Field-testing your unit for cleanliness is where the problem comes in. But there is one indirect method of checking cleanup which we find practical and effective for field work.

As you know, in a reciprocating refrigeration system the oil travels through the system and eventually comes in contact with all components, piping and refrigerant. Oil seems to absorb many contaminants and wash solids

# hermetic compressor burns out

**A burned-out motor in a hermetic refrigerating system can contaminate the entire cycle. Here's how to guarantee cleanup after failure**

back to the crankcase. Therefore, we'll test the oil to determine extent of contamination. Oil sampled should be taken directly from the crankcase without first pumping down the compressor.

**pH of the oil** will be used to indicate how severe the burnout was. Don't misconstrue the word "severe" to mean how badly the motor was destroyed. Think in these terms: How low is the acid number? How deep into the system have these contaminants penetrated? For instance, a motor that received a direct short on starting would knock off the line immediately and coast to a stop. The motor would be destroyed and the compressor shell messy, but the short running time would not have allowed contaminants to penetrate very far into the system.

Equipment needed for cleanup-checking process includes a 60-ml separatory funnel, 100-ml graduated cylinders, test litmus papers, distilled water, clean rags, solvent, rubber gloves and refrigerant oil.

**Step-by-step procedure** should be followed rigorously to assure effectiveness. Here is the outline:

(1) In a graduated cylinder, collect a 15- to 20-ml oil sample directly from crankcase. Let it stand about 15 seconds, measure quantity as accurately as possible and record. Do not pump down

(2) In another graduated cylinder, measure out a quantity of distilled water equal to the oil sample

(3) Pour water and oil into the funnel

(4) Shake funnel vigorously for at least 30 seconds and then stand funnel in the cylinder that contained distilled water

(5) Let the mixture stand for several minutes until a clear solution begins to appear in funnel bottom.

(6) Remove the stopper and open stop valve of the funnel just enough to allow the clear aqueous solution to drip until a few milliliters are collected

(7) Determine the pH of this solution, using the test paper

(8) Record this pH as *initial.* Note: Perform all subsequent oil tests according to these eight steps

(9) Discharge the oil-refrigerant mixture in the liquid phase. *Do not handle mixture!*

(10) Test new oil and record pH as the *end point*

(11) Disassemble compressor as completely as possible and wash all parts with solvent. After cleaning, wipe each part immediately with clean compressor oil and cover with rags. Be sure all gas and oil passages are clear. Inspect terminal block for carbon deposits and burned insulators. Check oil sight glass for pitting

(12) Reassemble the compressor, leaving off valve plates and heads. Charge compressor with oil

(13) Run the compressor for five or ten minutes. Keep a close watch on the oil pressure while running. If pressure falls, stop the compressor and correct the trouble

(14) Drain oil, recharge with new oil and assemble the valve plates and heads. Pull a vacuum on the compressor with the service valve closed—this should all be done in the same working day if possible. Do not connect piping to compressor at this time

(15) Open all valves in refrigerant piping by hand and remove all filters and screens. Flush coils and piping with solvent using drum pressure or chemical pump to force solvent through. It is difficult to clean a water-cooled condenser. Only method is to flood refrigerant side with solvent, allow it to stand or circulate it with a pump and tank, then drain condenser. The hot-gas pipe may merely need flushing. If it is too dirty, and short enough to make this practical, it can be cleaned by drawing solvent-soaked swabs through it. Clean receiver in the same manner as the condenser

(16) If system does not contain a filter dryer or moisture indicator, install one

(17) Close entire system and prepare for leak-testing and dehydration. Triple-dehydrate system, each time breaking vacuum with dry nitrogen. Be sure to obtain at least 30- to 35-F-wb indication

(18) Install dryer cartridges and charge the system with refrigerant through the dryer

(19) Operate system for 15 to 20 minutes, stop compressor without pumping down and close service valve. If filter dryer is in the bypass, be sure to run all refrigerant through the filter during run-in

(20) Test oil sample

(21) Drain oil. Observe its color and cleanliness. Open the crankcase and wipe inside walls and terminal block; wash the oil screen. Recharge with oil. If oil screen and terminal block are clean, there will be no further need to open the crankcase

(22) Run the compressor for three hours and then take another oil sample. Change the oil after each of these running periods. If the pH tests high, increase the running time to about a week. If pH is still high but the oil appears clean, there is no need to change the oil again. Now let the machine run for 30 days and at the end of this running period check the acid number and change the oil. As soon as pH is close to or the same as the *end point* pH, system can be considered clean. Record this pH as final

(23) New filters should be installed at this time. They will handle all the filtering that remains to be done and also remove any remaining acid. Filters are an effective cleaner and should not be skimped on because of their seemingly high price—they're well worth it.

Today's electric insulation resists contamination, but don't think this excuses you from giving it proper maintenance. To get topnotch service, reliability and long life . . .

# Match winding care to insulation life

By F A SCHEDA, Westinghouse Electric Corp

In recent years, electrical manufacturers have developed insulating materials with amazing resistance to water, conductive and hydrophyllic contaminants, solvents, corrosive and inflammable chemicals and fungus. (See POWER's *TD* report on electric-motor insulation, Feb 1960, p 61 for newer materials' characteristics.

**In spite of advances,** insulation hasn't reached perfection. Main limitation: no insulation system in use today escapes the problems of old age. True, life expectancy is very high; even with the most serious contamination, probability of premature in-service failure is low. But probability of failure rises as machines operating in contaminated atmospheres grow old. In other words, as an insulation system grows older its life becomes more difficult and more expensive to insure. Still, reasonable insurance is possible—through proper and regular maintenance procedures.

Maintenance man is an insulation system's only physician. He must study his machines and determine what type of maintenance they need. He must examine the winding for symptoms of old age: decrease in insulation thickness, varnish embrittlement or softening, color changes. He must determine whether or not corona or tracking erosion have caused winding damage. He should also inspect each machine for scratches, nicks, cuts or other physical damage. After each inspection, the contamination should be removed and damaged portions of the winding repaired.

**Cleaning method** depends on type of insulation and type of contamination. Five common methods are vacuum cleaning, washing with water, drying, steam cleaning, solvent cleaning. Common contaminants are carbon and coal dust; salt, flour, household dust; water, acids and bases and other water-soluble substances such as dirt and clay. Any of these can mix with oil and grease, creating special cleaning problems that require special cleaning methods. Finally, consider the effects of each cleaning method on old Class-A and Class-B machines, silicone insulations and other new materials.

Each cleaning method brings up some questions. On what type of insulation can this method be used? Against what type of contaminant is it most effective? How should it be done? What are its advantages and disadvantages from the overall view?

**Vacuum cleaning** can be used on any insulation system. It's useful with carbon or coal dust as well as household dust, flour, etc. You can do the job best with an industrial vacuum cleaner. Caution: always de-energize windings before starting cleaning.

Main advantages of vacuum cleaning: contaminant is removed from the exposed portions of the winding and need not be scattered through the atmosphere. But unfortunately the inner recesses are not thoroughly cleaned, and if your winding is wet or covered with an oil or grease film the method is not sufficient.

**Washing with water** is especially recommended for silicone insulations and newer encapsulated systems. Quite effective at removing water-soluble contaminants—many salts, dirt, clay, acids and bases—it can, in some cases, even get at contaminants held to the winding by an oil film. Hot water at 80 C (176 F), either plain or with a mild non-film-forming detergent, can be used to flow off these contaminants. Water pressure should not exceed 30 psi and the stream should be directed at the winding so contaminants flow away from the inner recesses. But this technique won't work with greases. And always after cleaning a thorough drying is necessary. In some cases, though, you need only wipe the excess water from the surface to dry encapsulated windings of newer designs.

**Drying,** compatible with any insulation system, is the only method known for removing water. Technique depends on type of apparatus to be dried and facilities available.

If the machine will go in a forced-air oven, baking will remove the internal water. (Start at 90 C and after about four hours increase to 100 C.) Large individual motors can often be dried by an improvised oven or "hot box" heated by electric grids or space heaters. You can manufacture a source of hot air by mounting space heaters inside an old oil drum. A fan at one end of this drum takes air from the other end and circulates it through the machine.

Drying with internal heat is often practical; this involves circulating current through the windings. A dc source will do this, or in the case of generators internal heat is produced by short-circuiting the armature, driving the machine against a weakened field—as specified by an electrical engineer who knows the machine.

As a last resort, try infrared lamps. But the surface temperature of the windings must be measured by thermocouple (many kinds of thermometers cannot be used); surface of the winding should not exceed 100 C (212 F).

**Steam cleaning** is especially good with silicone insulations and newer encapsulated systems, but has been used successfully on all types of insulation. It is effective against most contaminants.

Industrial steam generator is best but improvised units can be used. For best results, steam pressure in contact with the winding should not

## How to clean contaminants from windings

| Method | Water soluble dirt and clay | Dust[1] | Dust[1] and oil | Dust[1], oil and grease | Acids and bases | Water | Type of insulation |
|---|---|---|---|---|---|---|---|
| Vacuum cleaning | No | Yes | No | No | No | No | All |
| Washing with water | Yes | No | No | No | Yes | No | Especially silicone and epoxy[2] |
| Drying | No | No | No | No | No | Yes | All |
| Steam cleaning | No | No | Yes | No | No | No | Especially silicone and epoxy[2] |
| Solvent[3] cleaning | No | No | No | Yes | No | No | Especially epoxy[2] |

Notes: (1) Including carbon (2) All insulations with due precautions (3) Stoddard solvent or equivalent

exceed 30 psi. In all cases, winding to be cleaned should be de-energized and maintenance man must never be without some form of protective goggles. Mix a non-film-forming detergent with the steam-generator water—trisodium phosphate and a wetting agent is an example. Add 0.1% of this compound by weight.

During steam cleaning, use a separate source of warm rinse water to flow away dirt lifted by the steam. Imperative: rinse water must flow *away* from the internal recesses of the winding. Dc armatures should be suspended with commutator up.

Steam cleaning seldom works against severe grease contamination. However, it has been handy in cleaning traction motors and shovels where contaminants are somewhat water-soluble. Steam cleans mining motors successfully, too. Most serious objection has been the very thorough drying sometimes required.

**Solvent cleaning** is effective but dangerous if not done right. Many installations, especially the epoxies, have excellent solvent resistance. However, most effective solvents are so toxic (carbon-tetrachloride vapors) or inflammable (gasoline) that they are not recommended at all. Besides, these dangerous solvents in some cases seriously harm an insulation by lifting the film or softening varnish.

Only petroleum distillates classified as "safety type solvents" should be used to clean electrical windings. Stoddard solvent (described in the specifications of the U. S. Bureau of Standards, 1940, "Commercial standard CS3-40") and solvents sold by motor manufacturers are successful. They're compatible with all insulations, but don't let them stay in contact with the windings for long periods of time. Solvent technique is especially useful to remove contaminants mixed with grease and oil.

Solvents can be pumped through a hose and allowed to flow over the winding. Protective clothing, especially neoprene gloves, is vital since there is danger of skin irritation. Ground connections should be made on the metal parts of the hose; protective masks or other respiratory protectors should be used. Adequate ventilation must prevent accumulation of explosive mixtures of vapors and air. Above all, windings *must be de-energized* before applying solvent. It may be a good idea to wipe the winding with a solvent-saturated cloth before beginning the cleaning operation, to remove loose dirt.

Main disadvantage of solvent cleaning is the danger involved. Failure to observe the proper maintenance procedures could result in the death of an operator. In general, main advantages of solvent cleaning include the short drying period required and the take-it-or-leave-it fact that solvents are the only way to clean windings heavily saturated with greases.

**Revarnishing windings** involves these questions: What are the procedures to be followed before varnish treatment? What type of varnish? What is the best impregnation technique which you can employ?

Machine must be clean and dry before varnish is applied. Varnish should be the same type as that used previously—or you're risking incompatibility. Incompatible materials react with each other or catalyze the thermal-degradation reactions, result in short thermal life for the insulation. There is also danger that the dielectric constants of different materials would not match. Then most of the voltage stress in the insulation might fall across the original varnish, causing early electrical breakdown.

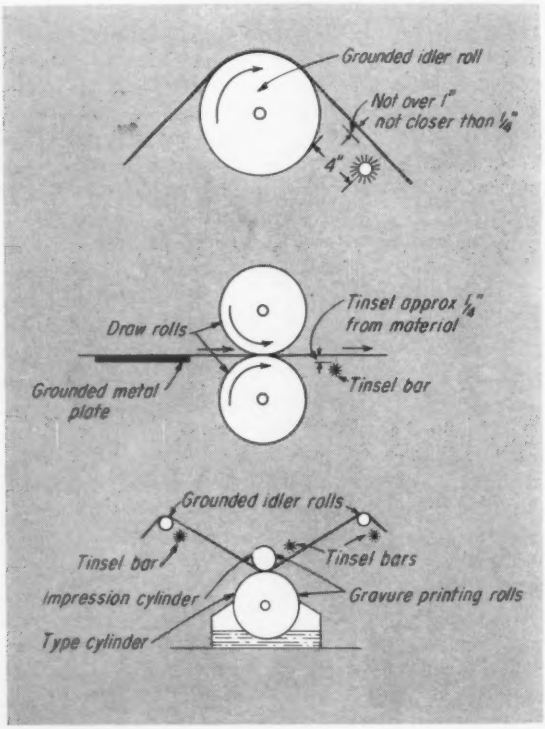
When possible, consult machine manufacturer about varnish type, temperature, viscosity, application, baking cycle and number of treatments that will be required.

Vacuum impregnation gives best results since cracks are well filled. Here's how it's done: (1) Place the apparatus in the impregnating tank (support dc armatures with the commutator up). (2) Seal the tank, draw a vacuum of 25 to 28 in. and maintain for at least one hr. (3) Flow varnish in until winding is completely covered. (4) Let air into the tank until the pressure reaches atmospheric. (5) Let varnish stay in the tank at least one hr. (6) Pump varnish back into the supply tank, bake the apparatus as manufacturer prescribes.

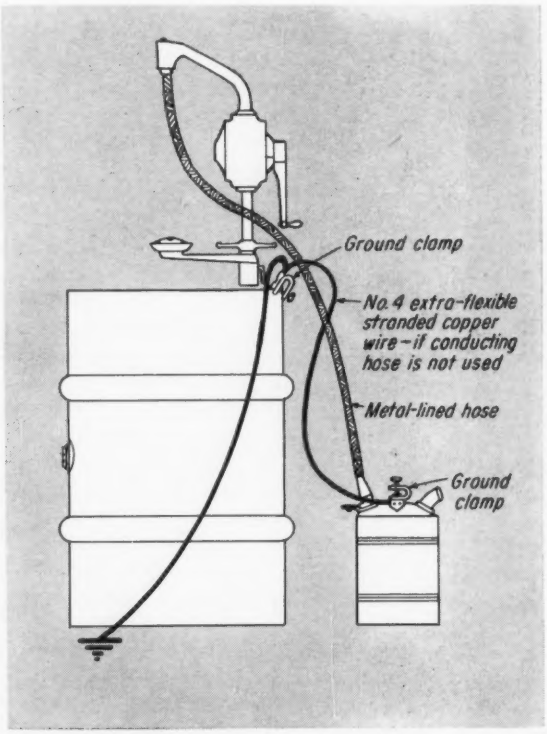
# Reduce that static-electricity hazard

By NORMAN PEACH, Associate Editor

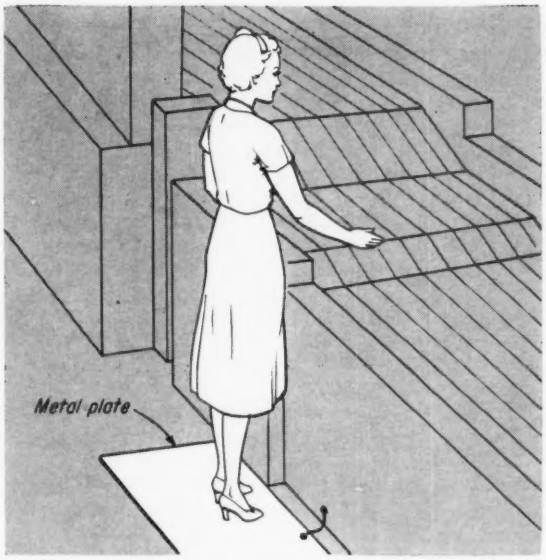
Static electricity is a charge that builds up on isolated or nonconducting surfaces. It has many causes around the plant: a belt moving on a pulley, paper or fabric on rollers, liquids flowing in pipes. In fact, any process in which dissimilar materials are brought into contact and then separated is a possible source. Danger comes when static electricity discharges—sparks—in presence of flammable or explosive liquid, vapor or dust. Most plants can't help but have some ignitible substances around, so it's a good idea to take simple precautions to prevent static buildup. Study static problems carefully in hazardous locations.



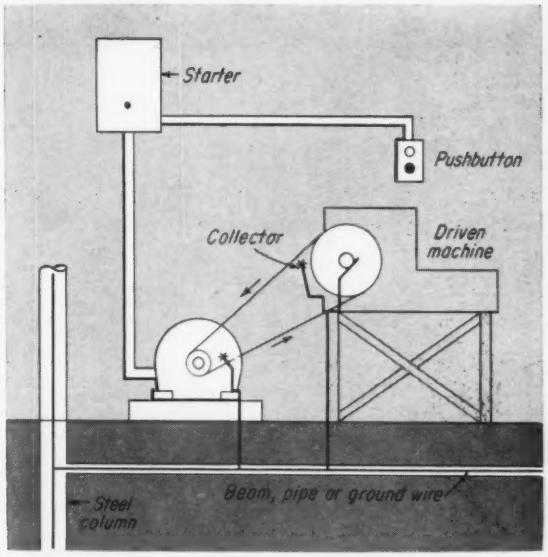

**COLLECTION** of static charge from nonconducting materials in motion usually begins with a bar, preferably nonconducting, wrapped with grounded conducting tinsel. Bar is placed close to material but not touching it. Combs collect static from belts in the same way, but must be kept at proper distance to avoid a discharge spark



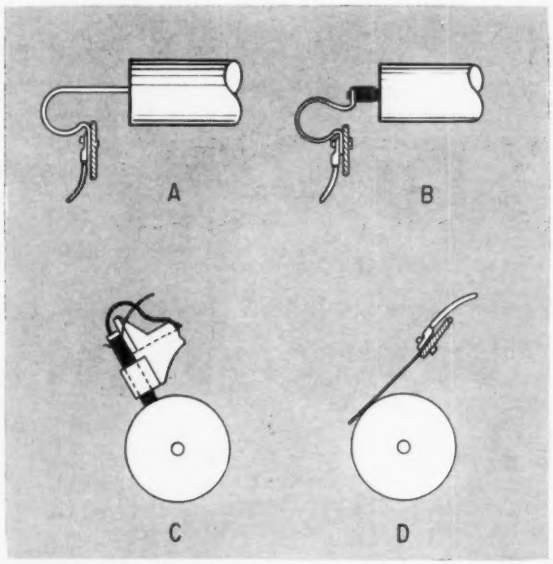

**FLUID CONTAINERS** should be bonded and grounded. Here we show an arrangement for a solvent drum. Large-scale variations of this can be used for filling tank cars or trucks. Liquids or gases flowing in pipes or coming out of nozzles are likely to generate static and should be bonded to ground wherever hazardous materials are being handled



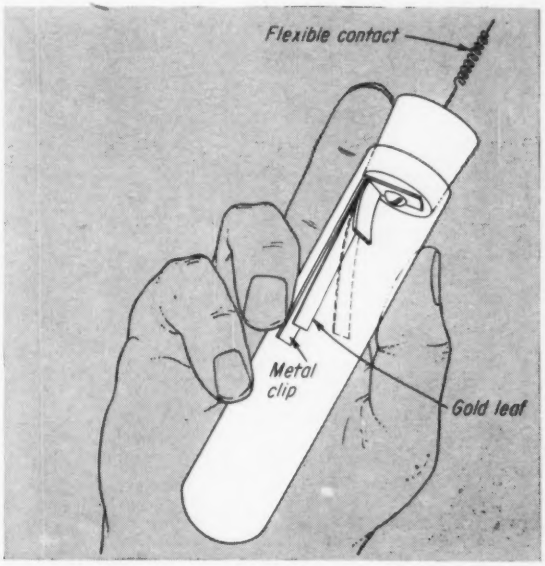

**HUMIDIFICATION** is probably most-effective way to control static electricity—where process permits it. Relative humidity of 50% creates a moisture film to carry off charge. Clothing, especially certain synthetics, may generate static; rubber-soled shoes may act as insulators. Conducting shoes on a metal plate are sometimes advisable




**GROUNDING** is usually the most practical way to combat a static charge. Its disadvantage: it must be maintained. Any accidental opening of grounding bonds may permit static buildup. Belts and pulleys are a common source of static electricity, but belt dressings, metal pulleys and properly grounded shafts are effective controls




**SHAFTS AND ROLLERS** can be grounded positively by any of these methods: (*A*) spring-bronze clip (*B*) brass or carbon brush (*C*) carbon brush and holder (*D*) spring-bronze brush. For details on static-electricity hazards write for reprint No. 77, *Static Electricity*, National Fire Protection Assn, 60 Batterymarch St, Boston 10, Mass.

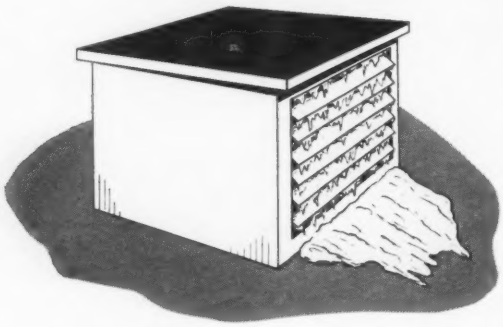



**DETECTION OF STATIC** is possible with several instruments. Simple gold-leaf electroscope detects—but doesn't measure—charge by movement of gold-leaf strip. It is safe—won't cause sparkover—and sensitive, but must be handled with care. Other detectors: neon-tube tester, electron-tube detector which also can be used to measure charge

# These **plant problems** could well be yours...

## Problem . . .

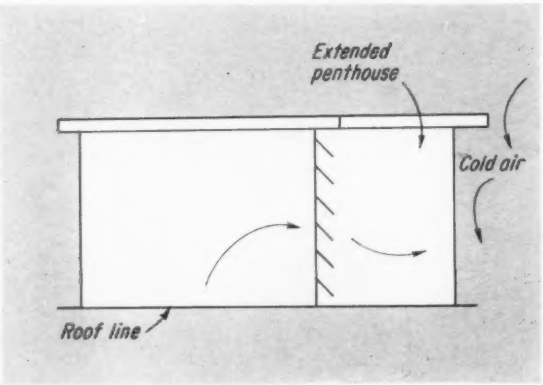
### Can we prevent exhaust-vent icing?



We operate a medium-sized dyeing and finishing plant recently opened in the New England area. Our plant includes several bays of dyeing vats producing moisture and fumes. To exhaust this saturated air we have a number of fans mounted below the roof and exhausting through louvered outlets in penthouses. In winter months we pull air through a series of duct openings which include steam-coil heaters. Air passes through finishing rooms and into the dyeing bays. Between the high temperature of this air entering the dyeing bays and the large amount of vapor put out by the vats, exhaust air is loaded with moisture.

Our problem arises when the outside temperature drops near 0 F. On those days exhaust air is chilled as it leaves the penthouse louvers to the point of not only condensation but crystallization. Heavy ice deposits build up on our louvers, blocking the openings and eventually cutting down on cfm exhausted by our roof fans. Short of chipping or steam-cutting ice off we have no solution. Can some reader suggest a permanent solution?—*DTP, March* POWER

## Solutions . . .




### Extend penthouse outlet

*DTP* could construct some permanent form of windbreak or enclosure, shown above, extending the outlet or discharge of air to a point well outside the louver. This will place the contrast of the saturated warm and cold air away from the louvers. If the penthouse is arranged differently, other ways of extending an enclosure are possible to give the same results.

A second proposal, if the first is not feasible, is to provide a "bypass" *open* discharge—no louvers—for operation during periods of low temperature only. But this would require the attention of plant personnel—not necessary for the extended-enclosure arrangement.

M L MYERS, *Knoxville, Tenn.*

### Modify exhaust-air dew point

Icing of the louvers can be prevented in cold weather if air's humidity can be greatly reduced. Offhand, I can think of three methods of cutting down moisture reaching the louvers. The first method is to install an induced-draft fan and change the ductwork so outside air is drawn in and mixed with the warm, moist air. Resulting mixture would be at a temperature well below the dew point of the moist air. Much of the moisture would drop out. Eliminator plates would have to be installed in the air stream after the mixture, and a drain provided.

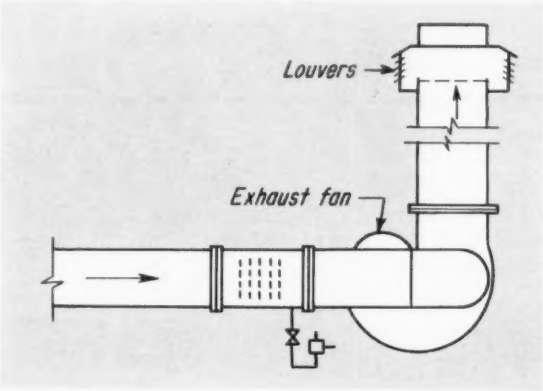
The second method: install a coil in the ductwork and a tank with a water and antifreeze solution outside the building. The solution in the tank would be pumped through connecting piping to the coil in the ductwork

# ...Here's how Power readers would tackle them

LAWSON STEWART, Associate Editor

and moisture would condense on the coil. There is one slight advantage in this: if the air is not toxic it can be mixed with the incoming makeup air and so save on heating load. Chief disadvantage: there could be a time lag in reducing the temperature of the antifreeze solution to where it would do any good.

The third method is the most expensive to install but under some circumstances could more than pay for itself. A refrigeration system is installed with the evaporator coil in the exhaust-air stream. The warm, moist air is an excellent heat source if the refrigeration system is used as a heat pump. Heat rejected to the condenser could be used for many purposes, the most obvious of which are preheating process water, heating offices or other space, drying material after it is removed from the vats. In addition, the system could be arranged to provide comfort cooling in the summer.—J BELUNAS, *Wyoming, Pa.*




## Put in a cooling-coil system

One method for limiting *DTP*'s problem would mean cooling and dehumidifying the exhaust air. With this arrangement, air dry-bulb temperature and relative humidity are lowered. Resulting condensation reduces moisture content and limits freezing tendency. Drawing above shows major components for this system. Coolant may be cold water from the plant supply or another source.

For cooling and dehumidification the coils are frequently rated to satisfy the following limits:

| | |
|---|---|
| Entering-air dry-bulb temperature, F | 60 to 100 |
| Entering-air wet-bulb temperature, F | 50 to 80 |
| Cooling-water inlet temperature, F | 40 to 65 |
| Water-temperature rise, F | 4 to 12 |

Exact values may be obtained from the coil manufacturer. The cooling element may be fabricated from pipe or tubing, or it can be a unit with extended surface. Latter offers maximum heat-transfer area, hence minimum space and weight for a given heat load.

Primary surface or tubes may be copper with aluminum or copper fins for secondary surface. For this type of application, lint accumulation or other particulate matter in the air influence fin spacing.

You must check the present exhaust systems to determine if added friction caused by the coils exceeds fan capability. A study of tube and extended-surface designs will allow selection of a unit requiring minimum pressure drop—figures are available from manufacturers.

If fans have belt drives, it may be possible to satisfy the greater pressure requirements by increasing fan speed. In this case, check motor for overloading.

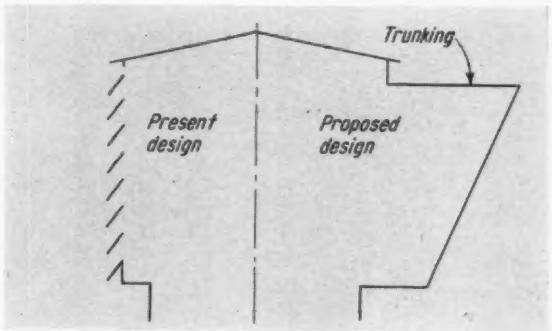
H B WAYNE, *Woodhaven, N. Y.*

## Replace penthouse with vent stack

A possible solution to the icing problem: use a stack on the fan discharge instead of discharging into the penthouse. Stack should have a converging-nozzle shape to give high velocity to the air stream. A further refinement would be insulating outside of the stack to preclude possible frosting of the inside.

An added benefit of this installation: preventing reentrainment of saturated air by the intake fans.

B M KECK, *Rochester, Minn.*




## Install trunk outlet in place of louvers

It appears to me that the way to eliminate the problem of ice-clogged louvers is to eliminate the louvers. Replace them with a length of trunking sufficient to prevent rain and snow entry.

Ice forms on the cold surfaces, probably helped by the throttling of the air as it passes between louvers. With trunk outlet shown above there is nearly twice as much free area to begin with. Ice would have to build up to an unlikely thickness before it began to throttle the outflow.

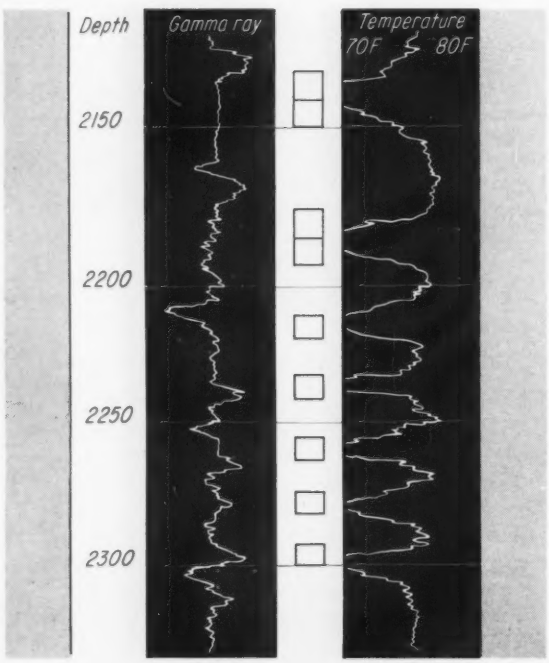
P D HOBSON, *Concord, Calif.*

# Problem . . . How to measure well temperatures?

In our business, producing steam from geothermal sources, we must measure temperatures in our wells at depths which may go down to 2000 ft. These temperatures can be as high as 500 F and vary independently of depth, although the overall trend usually rises as depth increases. Some wells are full of water. We must measure well temperatures immediately after drilling to observe cold spots and then watch them heat up—zones that heat up most rapidly will produce the most steam, so theory has it.

We have used three different instruments without complete satisfaction. First, a maximum-indicating thermometer which once it reaches a maximum at any point cannot indicate lower temperatures at another point in the well. We also used teflon-coated thermocouple wire, but teflon coatings are not always waterproof in our service. We tried a clock-mechanism recorder but found the timing undependable under high-temperature operation. Possibly some reader has a better solution.—*WMM, March* POWER

# Solutions . . . Try loggers used in mineral exploration




While we have few bore holes penetrating to *WMM*'s 2000-ft depths, one or two bores did reach a depth of 3000 ft. The latter were run for oil exploration that eventually produced gas in commercial quantities.

Reader *WMM* did not indicate an attempt to use the portable logging equipment that's used quite extensively in mineral exploration, so we suggest he investigate its potentialities. Such logging equipment, operated by his own field personnel, can produce extremely useful geophysical logs speedily and inexpensively, although the bores may be of the same small diameter produced by diamond bits.

The electric log consists of a temperature, resistivity and potential curve. These curves are recorded in terms of depths and plotted side by side as continuous graphs. The logs are obtained in open bores filled with water or water-based mud. Electric logs can only be recorded in open holes; the steel pipe in cased holes acts as shield and neither potential nor resistivity curves reflect the condition behind the casing. Temperature curves are not affected in the least.

We record temperature in the drill hole at a given depth. The temperature depends on the original temperature of the formation as modified by the drilling

process and by thermal changes between the drilling fluid—if *WMM* uses such an aid—and the formation. Studying the temperature logs recorded at intervals let us identify certain formations.

In the Frasch sulfur "mining" operations in the Gulf regions, temperature logs are used to follow the sulfur heating process. For *WMM*'s information, high temperatures affect all gamma-ray logging equipment employing scintillation counters. Since his temperature maximum is 500 F, the sensitivity will be reduced and the statistical variation increased accordingly. There is an out, however: special-order probes are available with high-temperature insulations.

Logger consists of a downhole tool connected to a reel-mounted insulated cable, a depth-measuring device, a control panel and an automatic recorder. The depth-measurement device actuates the chart-drive mechanism so chart moves in synchronism with the downhole tool. Recording pens move according to the amplitude of the signals sent by the downhole tool to draw the corresponding curves.

Multiple-electrode loggers permit recording potential and several resistivity curves. These are somewhat more complicated and expensive. But they let you get quantitive information.

The same basic equipment is used for gamma-ray, temperature and caliper logging. You have to buy accessory control panels and special logging tools for this work as needed. The logging tools are equipped with heads for a quick change to the extremity of the logging cable.

Drawing, above, shows a typical temperature and gamma-ray log developed with the aid of the portable logger.

L. HOBEN, *Oak Ridge, Tenn.*

## Pipe couple may answer your problem

Some years ago, I probed a cold-water well to determine temperature at various levels. After several unsuccessful attempts with thermometers, we made a thermocouple case of screwed ¼-in. pipe. Couple was cemented to the inside of a homemade socket with a ¼-in. male pipe thread on the end. Lead wire was stretched out on the ground and ¼-in. pipe slipped over the wire. Then we slid each piece into the top of the well casing and screwed it to the preceding pipe until the proper depth was reached. Counting lengths of pipe gave us an accurate measure of the level. Quick-setting waterproof thread compound was used on the threaded joints.

Our probe was a success and the pipe and lead wire were returned to stock. We saved couple and socket for possible future use.—B M KECK, *Rochester, Minn.*

# Your June problems

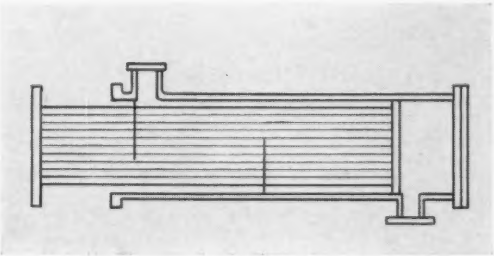
## What type of heating is best?

We are in the initial planning stage of a school expansion, a separate building housing gym, auditorium, shop and art room. Seating capacity of the auditorium is set at 1200.

Because of piping restrictions and placement of the new building it seems that a separate heating system is in order. If we do decide on a separate system, we aren't bound to make it the same as our existing one.

Our problem is an old one, but economic and engineering factors change so frequently we would like to bring our thinking up to date. Our question: which type of heating system is best for a load of this sort? The school is located in northern New England, and all areas may be used for community functions.

Can POWER readers help us?—*LSM*



## How should we handle tube bundles?

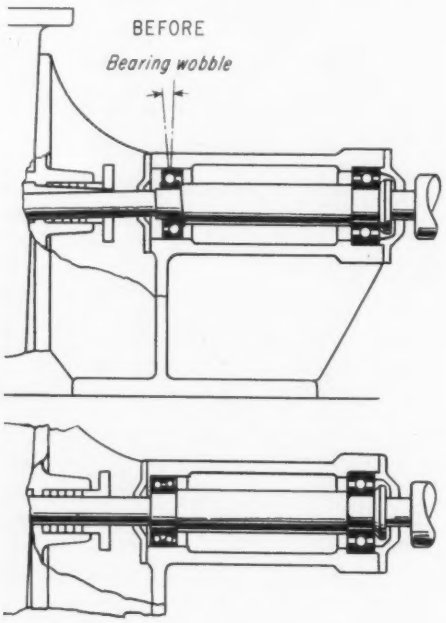
We are having trouble removing tube bundles from horizontal heat exchangers. Bundles, of the floating-head type, are 44 in. in diameter and weigh 20,000 lb. Shells are stacked three high. We have an overhead crane with hoisting capacity of 12 tons through two separately mounted cross-travel hooks. 12×12-in. beams are mounted on building steelwork opposite shells, in removal area.

We have difficulty supporting bundle weight during removal. Wire-rope slings bend tubes. Since transverse baffles are 42-in. apart it is hard to lay something across them to prevent tube bending. We used 5×1¾-in. channels, but these bent and dug into the tubes. In pushing the bundle back, we plowed a furrow in the shell. We are afraid any repetition of this will ruin the shells.

Can any POWER reader tell us how to pull these bundles without denting them?—*KWB*

**Sit down right now and answer one or both problems. We'll pay extra for answers with photos or sketches**

# Timely **practical ideas** to help solve




## Select bearings for maximum packing life

Metallic packing served well enough on our larger-sized single-suction centrifugal pumps. But packing life was short for smaller pumps on same service. We had scored shafts, dangerous temperatures and the cost of worn-out bearings, shafts and packing to contend with.

After reviewing all conditions which could possibly lead to this trouble, we traced our woes to shaft whip, caused by low radial rigidity of the single-row ball bearing.

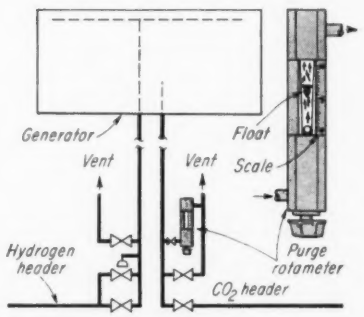
Since it wobbled, shown exaggerated, bearing could offer little resistance to shaft deflection. For maximum radial rigidity, and without any changes in existing shaft and housing dimensions, we mounted a double-row ball bearing. It was axially free in housing, as indicated in sketch.

This type bearing is built with its two rows of balls set against each other so they don't yield in the absence of thrust. Bearing's built-in resistance to shaft deflection now gives us more service from shafts and packings.—E WITTMANN, *Villas, N.J.*

## Don't overlook chrome plating

Operators in the hydro field might be interested to know that, for several years, we have been chrome-plating the bronze liners of our water governors. They are sent to an outfit specializing in such work and are ground to a superfinish. The rings on the governor valve are of monel or stainless. This combination has made a vast improvement in governor operation and has cut maintenance. Our bronze liners live much longer and do better work.

L MCWILLIAMS, *Shawinigan S, P.Q.*




## Rotameter does it

Our plant has two hydrogen-cooled generators. To keep purity at the required value we add hydrogen occasionally. This was done by slightly opening the vent valve on the $CO_2$ line and the bypass valve around the hydrogen-pressure regulator. Procedure took at least four hours a week.

After some thought we installed a purge rotameter in the $CO_2$-line exhaust to the vent, sketch. This is an easy way to control purity as the operator has a visual indication of amount of bleed.

G F BRILL, *Lake Charles, La.*

## Draft transmitter to rescue

A new pressure-fired packaged boiler with a low-pressure gas burner (0-to-5-in. $H_2O$) was tied into an existing 200-ft stack. This stack had so much draft that at low loads it actually made the pressure in the furnace negative. Negative pressure naturally traveled right on back into the burner.

Controls had the air paralleled off the burner pressure. But the gas-pressure transmitter wouldn't transmit a negative pressure. In addition, at the same load the negative pressure in the gas burner would change as the ambient-air temperature varied the stack draft.

Problem was solved by using a furnace-draft transmitter. We hooked it up as a differential draft gage across the gas burner and the furnace. That gave us the pressure drop through the burner nozzles, independent of static pressures. It worked fine.

L A WATSON, *Atlanta, Ga.*

# your tricky design and maintenance problems

STEVE ELONKA, Associate Editor

## Does fan run backwards?

We had a new pressure-fired packaged boiler. On this unit the forced-draft fan was a diffuser type with a compact 3-ph pancake motor. A diffuser fan will, in some cases, run backward at better than 80% of capacity. This was one of the first of those fans made by that firm. Fan lacked an arrow showing direction of rotation and there were no instructions.

We didn't realize the fan could come up to 80% of capacity running backwards. So when it didn't quite make capacity we thought it was slightly undersized, promptly ordered a larger one sent out. One day I was idly watching the fan stop after the unit had been shut down. Only it didn't stop! It came to rest momentarily and then ran in the opposite direction by virtue of stack draft.

We immediately switched two phases on the 3-ph motor, changed the direction of rotation, and much to my chagrin the fan made full load with capacity to spare. I wonder how many of those fans are running backwards today? I'll bet a few are.

L A WATSON, *Atlanta, Ga.*

## What would you have done?

Years ago I had the job of installing a 600-cfm cross-angle air compressor at a mine site. First I had to remove part of a very large concrete foundation by drilling and blasting out the unwanted sections. But in spite of the water-liner jackhammers, drill dust troubled both hoists and auxiliary equipment.

Casting about for a large canvas to tack onto the roof chords to separate the used from the idle portion of the large room, I learned of a side-show tent for sale by Ringling Bros at Baraboo, Wis., then their winter quarters. It proved a good investment, not only keeping out the dust but also saving heat for the overtaxed heating plant.

We removed the windows in the compressor section of the building to vent the outrushing gases at blast time. The railway-sized door was also removed for this purpose. Flying debris was controlled by using hardwood railway ties chained or cabled into a huge mat, then covered with wetted remnants of the old canvas tent.

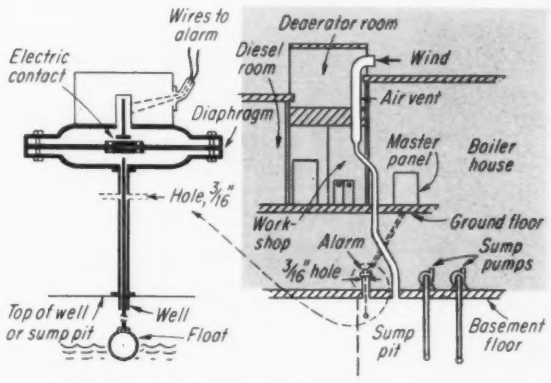
This story would not be complete without the epic finish, the grand finale. When the compressor was installed and put under full load, it purred along so quietly we could balance a silver dollar set on edge on the cylinder head. What would *you* have done?

P C ZIEMKE, *Clinton, Tenn.*

## No more false alarms

Every time high winds developed from north or northwest of our new airport heating plant we were plagued with almost constant false alarms from sump-pit high-water alarm system on the master panel.

The wind would create a downward pressure on the air vent. It was enough to cause the diaphragm on the alarm to make electrical contact, sketch. So it boiled down to either standing by the panel to reset the alarm system, or disconnecting the electrical system to the alarm.

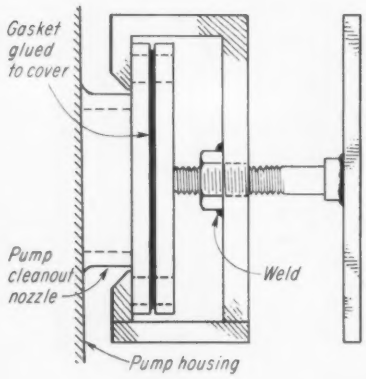



After putting up with false alarming for two separate shifts, I studied the system more closely. I solved the problem by drilling a 3/16-in. hole through the ½-in. pipe stand for diaphragm and electrical breaker.

Since then we have had no false alarm. Reason for this is hole is large enough to break the upward wind pressure on the diaphragm and thus prevent an electrical contact.

S DUPUIS, *Halifax, Nova Scotia*

## No more nuts to remove




Our many sewage pumps have large clean-out covers, held by four nuts which had to be removed at regular clean-out periods. This took time and energy because often we'd have to make a new gasket.

I fixed up a clamp, sketch, by welding together pieces of stock metal. A nut welded to center of clamp over hole saved a threading job. Then we glued the gasket to the cover so handling wouldn't harm it. This idea worked so well we now have clamps for all our pumps. Removing the cover is easy as turning the screw handle—no wrench needed, either.

A D McNULTY, *Berkeley, Calif.*

## Oil but no water?

The *M V American Press* was on its way from the States to Australia during the war. For prime movers she had twin diesel engines, driving a single screw through a magnetic clutch. Then, somewhere in the Pacific, the gears stripped on the port-engine turboblowers. Examination seemed to lay the cause of the trouble at the door of contaminated lubricating oil.

She made Adelaide, South Australia and laid up for repairs. New gears were ordered from the States. In the meantime attempts went forward full throttle to repair the damaged gears.

The chief engineer sent a sample of oil to the company for testing. Analysis showed better than 60% sludge. An Australian lubrication engineer hotfooted aboard. He asked the chief what type of oil purifier was on board and how often it was used. There were two centrifugal purifiers and the lube oil had been put through them 24 hours a day since leaving the States. The Aussie engineer asked for a look at them and their operation. One look was enough. "Why no water service on the purifiers?" "Simple," the chief said —"no water connections."

To make a good job of cleaning any oil, a small flow of water is needed. The water preferably is heated to the temperature of the oil, which usually runs through between 110 and 160 F, depending on specific gravity. With the help of centrifugal force, the water carries away more sludge, ups purifier efficiency. But—somehow —these centrifuges had no fitting for water.

The chief lost no time hooking up water connections. Then he ran all the contaminated oil through. In eight days they took out six 60-gal drums of sludge.

No particular credit can be given to the Aussie engineer, since one of the first things you should think of when purifying oil is running the right amount of water through. But since the chief and his engineers were in the dark, I wonder if Marmy would have hit on it straight away. Or would it have taken large quantities of his favorite thirst quencher to put him on the track?

T FRASER, *Kogarah, N.S.W., Australia*

## My biggest boner

We burned slurry in two 15,000-lb-per-hr boilers. The tipple foreman had taken the centrifugal dryer down and overhauled it. Not so good. He wouldn't admit it wasn't drying the slurry, so he came into the boiler room to dress down the firemen, the watch engineer and me. It was supposedly our poor operation and not wet slurry that caused trouble.

We had been mixing coal in with the wet slurry, and he claimed it wasn't necessary. He dashed around the boilers, changing the draft, stack and depth of slurry on the grate. The fires were rapidly going out.

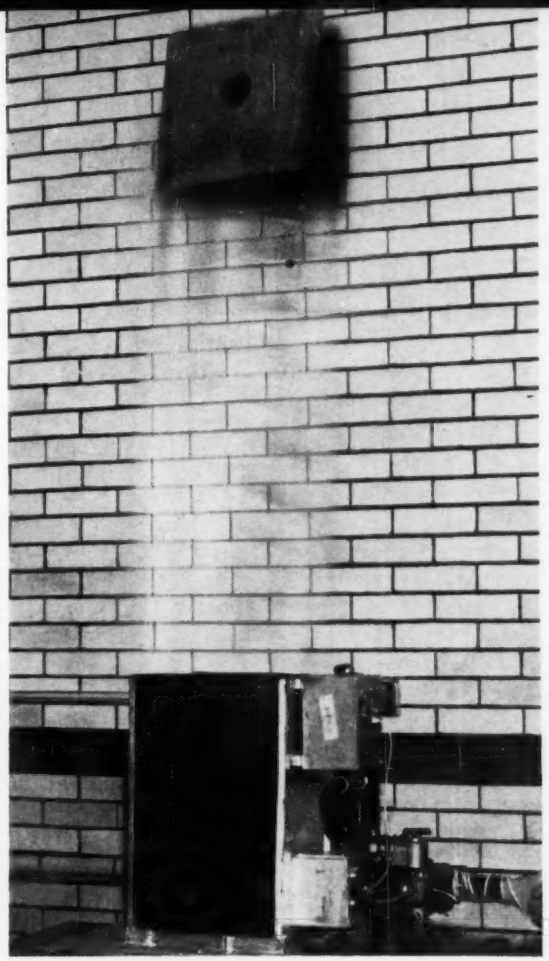
Then he had the tipple roustabouts start a bucket brigade of fuel oil to dump on the slurry in the hopper. Still no improvement.

He opened the fire doors and started throwing fuel oil right into the furnace on top of the slurry. It puffed and wheezed. Finally he opened it once too often and the oil flashed. WHAM!

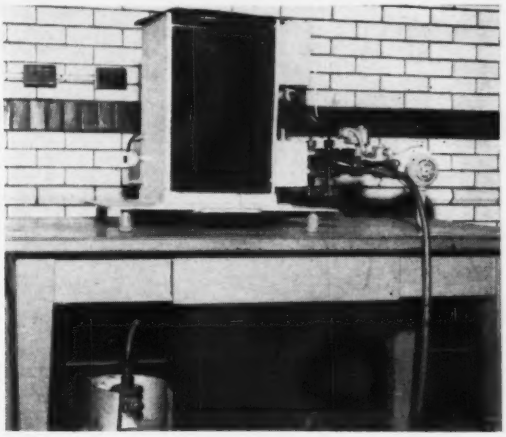
The foreman lost his eyebrows and whiskers. A month later he was back from the hospital and on the job. That was several years ago and I haven't seen him in the boiler room since. I believe the moral is self-evident.—C G HOWATER, *Canton, Ill.*

## Want a date?

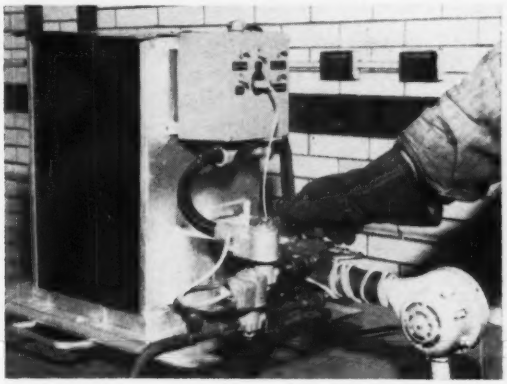
Label shown in sketch is used on our lube-oil filters and other equipment. Date shows when the oil filter was changed or last time a motor or other equipment was serviced. This tape can be purchased from any stationery supply house. It's a dandy reminder. —M L MONSON, *Fosston, Minn.*



**UP SHE GOES!**—improper purging and a "hot spot" send the sheet-metal cover of this simulated furnace shooting toward the ceiling



**MODEL** is small enough to carry around to plants, demonstrate to operators. Propane fuel and small blower are used



**ELECTRICAL** controls and burner team up to show common causes of puffs. Glass lets spectators view combustion

# Furnace puffs . . .

## look real as life, simulated by this model

Damage from furnace puffs is reaching such alarming proportions that at least one large utility, Consolidated Edison Co of New York City, has started a constructive campaign against them. Their answer: the working furnace model pictured on this page. With it they simulate a number of practical situations that cause furnace puffs.

Results are dramatic, realistic and most convincing: spectators are scared stiff when the first puff sends the model's cover flying toward the ceiling. Technical editors and boiler operators saw this very clearly at Con Ed's Waterside Station on Feb 17th as Fredrick Lennox, Superintendent of Production at Arthur Kill Station, demonstrated his realistic model.

Propane gas is the fuel. A small blower supplies air. To start the dirty work rolling, a tiny electric spark simulates a "hot spot" on the furnace floor.

**A number of situations** causing furnace puffs were set up. Lennox first demonstrated proper furnace lightoff, with, of course, no puff. Combustion gases from the clean flame vented through a hole in the light sheet-metal cover of the model. Then he set up a delayed ignition. When he touched the ignition button, the gas-filled furnace let go with a bang, flinging its cover ceilingwards.

Next the burner was lit off improperly—another puff. Next puff was caused by loss and re-establishment of fuel supply. Then a final puff, triggered by fuel accumulation in a "down furnace" ignited by a hot cinder. These are all-too-common situations that cause expensive downtime damage to furnace—and sometimes to personnel as well.

**Question-and-answer** period followed, and the alerted boiler operators took vigorous part. Everyone had a most healthy respect for proper purging and lightoff after it was over. A time bomb could not have been more convincing. While Con Ed has an excellent safety record, they feel the best time to lock the barn door is *before* the horse is stolen. With numerous high-pressure boilers scattered about Greater New York, they're working with a lot of horsepower. And they mean to keep it safe.

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**Mechanical Engineer — Experienced in design** and maintenance of industrial heating, air conditioning and steam distribution systems for a large medical research center. Excellent opportunity to grow with organization. Beginning salary $8,955. Federal Civil Service Merit System position with all retirement, leave and insurance benefits. Relocation expenses reimbursed. Write Mr. Ross Holliday, Plant Engineering Branch, National Institutes of Health, Bethesda 14, Maryland.

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**LOCATION FAR EAST**
Qualified applicants submit resume to
**THE KULJIAN CORPORATION**
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**MECHANICAL ENGINEERS**
Immediate opening for Project Manager and Project Engineer experienced in design of power plants; piping; and heating, ventilating, and air conditioning. Extremely wide variety of work with established Midwest consulting firm. Permanent. Good starting salary, advancement, and vacation program. Moving expenses paid. Send complete resume to
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**Chief Engineer, age 39, technical education, 15** years experience in the operation, maintenance, construction, and betterment of turbo-electric power plants. PW-6183, Power.

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Submit resume of academic training, experience and salary in confidence to

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## MECHANICAL ENGINEERS

Project level positions open in both Chicago and New York offices of established consulting engineering organization. Minimum qualifications: BSME degree, power option, 10 years experience in design of steam-electric generating stations; ability to perform all calculations and write specifications for equipment, controls and installation contracts. Duties include supervision and manpower control of mechanical design-drafting group. Balanced personality required for client contact and internal coordination. Career opportunity and possibility for eventual ownership participation. Submit two copies of complete resume.

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**for the U. S. Government**

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Diesel-power plant consultant, experienced in power plant operation and/or maintenance (may be at supervisory level), knowledge of both mechanical and electrical engineering essential. Professional registration desired. Salary $10,635. U. S. Navy, Bureau of Yards and Docks, Washington 25, D. C.

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Capable man with broad experience in specification writing for mechanical phase of building construction work is sought immediately by large Midwest consulting firm. Moving expenses paid. Resume showing educational background, experience, and personal qualifications should be sent to

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2. **15CFM**, 5000 Psi,—4 Stage, Air Cooled, 15Hp 220/440 Volt Portable.
1. **155CFM**, 100 psi, 8x8, 30 HP 220/440 volt motor.
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Engineer with imagination and drive to supervise group activities and outside representatives. Send complete resume and salary expected. P. J. Hamm, Mgr. Condenser & Pump Dept. C. H. Wheeler Manufacturing Company, Philadelphia 32, Pa.

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## TURBINE-GENERATOR SETS

12—General Electric 600 KW, AC, 60 cycles, 450 volts, steam pressure 525 PSI at 825°.

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**CApitol 8-8691**

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Superheated Steam: 16,500 lbs/hour—
Saturated 7500 lbs/hour
Superheater Outlet Temp: 450°F
Working Pressure at Superheater Outlet
200 P.S.I.
Length 16'7", Width: 14'8", Height: 15'4"

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**HUGO NEU CORPORATION**
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How to use: Check the dealer ads to see if what you want is not currently advertised. If not, send us the specifications of the equipment wanted on the coupon below, or on your own company letterhead to:

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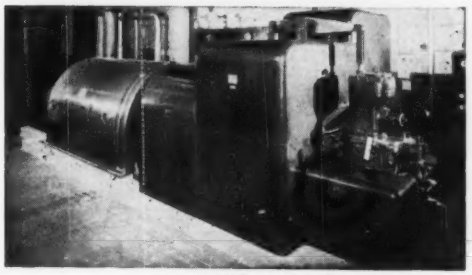

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3/60/2400, 80% P.F.

Built by Westinghouse

**Other turbine Generators**

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| 1-2000 KW GE | 600‡750° Non-Cond. 150‡ BP 4160V/6600V |
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| 1-7500 KW Allis-Chalmers | 850‡ 850° Non-Cond. 110‡ BP. |

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Engines — 715 HP — Vee type — 8 cylinder — 8½ x 10½ — air starting — 720 RPM — 2 cycle — heat exchanger cooled. Engines drive 500 KW Allis-Chalmers D.C. generators—120/240 — 2080 amps — 720 RPM — compound wound. Complete with a very generous supply of spare parts. IF YOU NEED D.C. POWER, NOTHING CAN BEAT THIS VALUE. FULLY GUARANTEED.

**NOTE:**

We can also quote you using the above engine — radiator cooled and with an A.C. generator — either 440/2300 or 4100 — and offer a completely portable unit.

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**(1) UNUSED 250 KW UNIT**

440/3/60 — 900 RPM Westinghouse generator — driven by a Cooper-Bessemer 8¾ x 11 engine model F.S.6 — Heat exchanger cooled. This is an unused set in prime condition. Will demonstrate. Unit is a slow-speed heavy duty diesel generator.

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**With Switchgear**

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ELGIN 5-5050 LEXINGTON 9-1900

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| 450 | 4000/2300 | G.E. | 1200 |
| 400 | 2300/440 | G.E. | 600 |
| 400 | 4000/2300 | Whse. | 720 |
| 350 | 440/220 | G.E. | 1800 |
| 300 | 4000/2300 | G.E. | 720 |
| 300 | 440 | Whse. | 3600 |
| 250 | 4000/2300 | Al. Ch. | 600 |
| 200 | 2300 | G.E. | 600 |
| 200 | 2200/440 | G.E. | 720 |
| 150 | 440/220 | G.E. | 1800 |
| 150 | 2200/440 | Whse. | 720 |
| 125 | 2300 | G.E. | 600 |

**AC GENERATORS or SYN MOTORS, 60 Cy.**

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|---|---|---|---|---|
| 400 | 2300 | G.E. | TS | 1800 |
| 400 | 2200/440 | G.E. | ATI | 720 |
| 300 | 2200/440 | G.E. | TS | 1200 |
| 300 | 440 | G.E. | TS | 720 |
| 150 | 440/220 | Whse. | G | 1200 |

**SQUIRREL CAGE MOTORS**

| | | | | |
|---|---|---|---|---|
| 500 | 2300/4000 | G.E. | FT | 1200 |
| 500 | 2200/4000 | Elliott | SC | 1800 |
| 400 | 2300 | G.E. | FT | 3600 |
| 400 | 2300/4000 | G.E. | K | 1200 |
| 350 | 2300/4000 | G.E. | SEDP | 3600 |
| 350 | 2300/4000 | G.E. | K | 600 |
| 300(2) | 2300 | G.E. | FT | 3600 |
| 300 | 2300/4000 | L. Allis | FS | 1800 |
| 300 | 2300/400 | G.E. | KT | 600 |
| 250 | 2300/4000 | G.E. | K | 720 |
| 250 | 2300/440 | G.E. | K | 1200 |
| 200(2) | 440 | G.E. | Dr-Pf. | 720 |
| 200 | 2200 | G.E. | KT | 1800 |
| 200 | 2200 | Cont. | TEFC | 3600 |
| 150 | 440 | El. Mchy. | Dr-Pf. | 900 |
| 150 | 440 | Whse. | X-pf. | 3600 |
| 150 | 440/220 | G.E. | TEFC | 720 |
| 150 | 2200/440 | G.E. | TEFC | 3600 |
| 125 | 2200/440 | G.E. | FT | 1200 |
| 100 | 440 | Whse. | TEFC | 3600 |
| 100 | 440 | Cont. | X-pf. | 1800 |
| 100 | 2200 | G.E. | FT | 900 |

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2—1600 Amp., G.E., AL-50, 600 V., Air
1—1600 Amp., G.E., AL-50, 600 V., outdoor
1—1200 Amp., Whse., F-124, 7.5 KV, manual
1— 600 Amp., G.E., 15 KV, Sol. oper.
1— 600 Amp., Whse., 7.5 KV, outdoor, New.

**D. C. MOTORS**

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 140 | 230 | G.E. | CD | 850 |
| 90 | 230 | G.E. | CD | 1750 |

**MOTOR GENERATOR SETS**

| KW | Make | Input., AC | Motor Type | Output V., DC |
|---|---|---|---|---|
| 300 | Whse. | 4150/400 | Syn. | 250/125 |
| 150 | G.E. | 440/220 | Syn. | 250 |
| 125 | G.E. | 440/220 | Sq. Ca. | 125 |
| 100 | G.E. | 2200/440 | Syn. | 230 |
| 65 | G.E. B | 2200/440 | Sq. Ca. | 250 |

**TRANSFORMERS 60 Cy.**

3—500 kva, G.E., 13,800—240/480 V.
3—200 kva, Mol., 13,800—2300 V.
3—333 kva, G.E., 13,800—2400 V.
3—333 kva, G.E., 2400—240/120 V.
3—333 kva, Whse., 2400/4160Y—240/480 V.
1—300 kva, Whse., 4160—480 V., Dry, New
3—250 kva, Whse., 2400/4160Y—240/480 V.
3—240 kva, G.E., 460—230 V., 3 ph. Dry
3—200 kva, G.E., 2400—460V. Pyr.
3—200 kva, G.E., 13,800—480 V.
3—200 kva, G.E., 4156—480/240 V.
3—167 kva, Whse., 4156—480 V.
3—150 kva, Al. Ch., 2400—220 V.
3—150 kva, G.E., 13,200—2300 V.
1—150 kva, Whse., 4160—120/208Y V., 3 ph. Dry
3—150 kva, G.E., 460—230 V., 3 ph. Dry
3—100 kva, Whse., 2400—240/480 V., Dry
3—100 kva, G.E. 2400—120/240 V., Pyr.

*only partial listing*

**STEPHEN HALL & CO.**

HARRY J. RICE, Pres.

625 ADAMS ST., HOBOKEN 2, N. J.

Circle 509 on Reader Service Card

MOTORS • GENERATORS
TRANSFORMERS
NEW • REBUILT

**ELECTRIC EQUIPMENT CO.**

WORLD'S LARGEST INVENTORY
CALL COLLECT CL 4-9058
P.O. BOX 51 • ROCHESTER 1, N.Y.

Circle 510 on Reader Service Card

# PLATERS

2 Plates 10,000/5,000 Amps. 9/18 volts. Hanson Van Winkle Generators. 2 commutators. Driven by 150 sync. motors on steel fabricated base. Mf'd. 1954. Like new condition.

**RAINBOW ELECTRIC CO.**

2610 Green Bay Rd., Evanston, Ill. DA 8-6363

Circle 511 on Reader Service Card

# RE-NU-BILT ELECTRICAL EQUIPMENT

## 53 YEARS SERVICE

### MOTOR GENERATOR SETS

| Qu. | KW | MAKE | RPM | AC VOLTS | DC VOLTS |
|---|---|---|---|---|---|
| 2 | 4800 | G.E. | 450 | 2300/4600 | 250/300 |
| 1 | 2500 | WHSE. | 720 | 2300/4160 | 600 |
| 1 | 2100/2400 | G.E. | 450 | 2300/4600 | 250/300 |
| 2 | 1730/2100 | G.E. | 514 | 2300/4600 | 250/300 |
| 1 | 2000 | G.E. | 514 | 2300/4600 | 600/666 |
| 1 | 1500 | G.E. | 720 | 13200/6600 | 600 |
| 1 | 1250 | WHSE. | 720 | 2300/4000 | 600 |
| 1 | 1000 | G.E. | 900 | 2300/4000 | 600 |
| 1 | 1000 | G.E. | 900 | 6600/4000 | 260 |
| 1 | 1000 | G.E. | 720 | 2300/4000 | 275 |
| 1 | 500 | G.E. Unused | 1200 | 2300 | 300 |
| 1 | 500 | G.E. | 900 | 2300/4600 | 250 |
| 1 | 500 | G.E. | 900 | 440 | 250/125 |
| 2 | 300 | G.E. | 1200 | 2300 | 275 |
| 1 | 300 | WHSE. | 1200 | 2300/4160 | 600 |
| 1 | 200 | G.E. | 1200 | 2300/4160 | 250 |

### FREQUENCY CHANGER SETS

| Qu. | KW | MAKE | FREQ. | VOLTAGES |
|---|---|---|---|---|
| 1 | 12500 | WHSE. | 60 To 25 | 13200-13200 |
| 1 | 5000 | G.E. | 60/50/60 | 11000-6600 |
| 1 | 2500 | G.E. | 60/24/60 | 2400-2400 |

### 3 PHASE 60 CYCLE MOTORS SLIP RING

| Qu. | HP | MAKE | TYPE | VOLTS | SPEED |
|---|---|---|---|---|---|
| 1 | 1750 | G.E. | M-579BS | 4800/2400 | 1800 |
| 1 | 800 | G.E. | MT-428 | 2200 | 450 |
| 1 | 800 | WHSE. | CW | 550/2200 | 1776 |
| 1 | 600 | WHSE. | CW-32D | 440 | 1778 |
| 1 | 600 | WHSE. | CW | 440 | 850 |
| 1 | 550 | WHSE. | CW | 440 | 252 |
| 1 | 500 | WHSE. | CW | 2300 | 881 |
| 1 | 300 | WHSE. | CW | 550/2300 | 350 |
| 1 | 300 | AL. CH. | ANY | 2200 | 720 |
| 1 | 300 | GEN. EL. | MTP-561 | 2200 | 1760 |

### SQUIRREL CAGE

| Qu. | HP | MAKE | TYPE | VOLTS | SPEED |
|---|---|---|---|---|---|
| 3 | 1500 | G.E. | K.D.P. | 2300 | 3580 |
| 1 | 1000 | AL. CH. | ANW | 2300 | 1180 |
| 1 | 550/275 | WHSE. | CS-1115 | 2300 | 863/445 |
| 2 | 500 | WHSE. | CSP-583H D.P. | 440 | 3600 |
| 4 | 300 | AL. CH. | ARW-D.P. | 2300 | 3600 |
| 2 | 450 | EL. | FR3910 | 2200 | 1185 |
| 1 | 400 | WHSE. | CS7151 | 6600 | 3565 |

### OUTDOOR G.E. METAL CLAD SWITCHGEAR 600 V. 3 POLE, A.C.B.

1—3000 AMP., AL-2-75, ELEC. OPER.
1—1000 AMP. AL-2-50, MANUAL
4— 800 AMP, AL-2-50 MANUAL
1— 400 AMP., AL-2-50 MANUAL
3—SPARE COMPARTMENTS

### PUMPS — MOTOR DRIVEN

6—600 G.P.M. Gould, Figure 3360, 8 Stage, 2310 Ft. Head, 1000#, 3550 RPM, Each coupled to 500 HP 3-60-3550 RPM D.P. Sq. Cage Motor

2—WHSE, Type CSP-583H, 440 volt

4—Allis Type 2300 volt Magnetic Encl. Reduced Voltage Starters

**BELYEA COMPANY, INC.**
**43 Howell St., Jersey City 6, N. J.**
**Phone: OL 3-3334—N.Y.C. RE 2-7150**

Circle 512 on Reader Service Card

### A. C. MOTORS—60 CYCLE

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 800 | Whse. (2) | Sq. Cage | 2300 | 1800 |
| 750 | El. Machy. | Synch. | 480 | 514 |
| 700 | G.E. | Slipring | 2300 | 514 |
| 600 | G.E. | Synch. | 480 | 900 |
| 600 | Elliott (2) | Sq. Cage | 2300 | 900 |
| 500 | G.E. | Slipring | 2300/4000 | 514 |
| 500 | Al. Ch. 3 brg. | Slipring | 440 | 514 |
| 500 | G.E. b.b. (2) | Synch. | 2300/440 | 1200 |
| 450 | Allis Ch. | Sq. Cage | 2300/440 | 720 |
| 400 | Whse. | Sq. Cage | 2200 | 514 |
| 400 | Marathon (2) | Sq. Cage | 2300 | 3600 |
| 400 | G.E. | Slipring | 2200/440 | 600 |
| 400 | G.E. | Synch. | 550/2200 | 400 |
| 400 | Whse. | Sq. Cage | 440 | 1200 |
| 350 | G.E. | Slipring | 440 | 900 |
| 350 | El. Machy. | Synch. | 2300 | 900 |
| 300 | G.E. | Slipring | 220/440 | 514 |
| 250 | G.E. | Sq. Cage | 440 | 1200 |
| 250 | Gen. Elec. | Sq. Cage | 440 | 3600 |
| 250 | Whse. | Sq. Cage | 2300/440 | 600 |
| 250 | Whse. (4) | Slipring | 2300/440 | 600 |
| 250 | Whse. | Sq. Cage | 2300/440 | 400 |
| 200 | Gen. Elec. | Synch. | 550/440 | 400 |
| 200 | G.E. b.b. | Sq. Cage | 220/440 | 720 |
| 200 | G.E. | Slipring | 220/440 | 450 |
| 200 | G.E. | Slipring | 440 | 600 |
| 200 | G.E. | Slipring | 2200 | 900 |
| 200 | Reliance b.b. | Sq. Cage | 220/440 | 1800 |
| 200 | Allis Ch. | Slipring | 2200/440 | 720 |
| 200 | G.E. | Sq. Cage | 2300 | 450 |
| 150 | Reliance b.b. | Sq. Cage | 220/440 | 900 |
| 150 | Whse. b.b. | Sq. Cage | 440 | 1800 |
| 150 | Whse. XP | Sq. Cage | 440 | 3600 |
| 150 | G.E. (4) | Slipring | 2200/440 | 600 |
| 150 | Whse. | Slipring | 220/440 | 1200 |
| 150 | Whse. | Sq. Cage | 220/440 | 1200 |
| 150 | G.E. | Sq. Cage | 2200/440 | 600 |
| 125 | Whse. b.b. | Sq. Cage | 220/440 | 900 |
| 125 | A.C. TEFC | Sq. Cage | 220/440 | 1800 |
| 125 | El. Machy (2) | Synch. | 220/440 | 400 |
| 125 | G.E. TEFC | Sq. Cage | 2200 | 3600 |
| 125 | Al. Ch. TEFC | Sq. Cage | 220/440 | 600 |
| 125 | G.E. (2) | Slipring | 220/440 | 514 |
| 125 | G.E. | Sq. Cage | 2300/440 | 1200 |
| 100 | Allis Ch. | Slipring | 2300/440 | 600 |
| 100 | Al. Ch. TEFC | Sq. Cage | 2200 | 1800 |
| 100 | G.E. b.b. | Sq. Cage | 220/440 | 3600 |
| 100 | G.E. TEFC | Sq. Cage | 220/440 | 1200 |
| 75 | A.C. TEFC | Sq. Cage | 2300/440 | 1200 |

### D. C. MOTORS

| MP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 250 | Cr. Wh. | 161-H | 230 | 1150 |
| 200 | Whse. b.b. | SK | 250 | 287/575 |
| 150 | Rel. TEFC b.b. | 2550-F | 230 | 850 |
| 150 | Whse. | SK-210 | 230 | 320/1000 |
| 125 | G.E. | CD-173 | 230 | 575/1150 |
| 100 | Elliott b.b. T.E. | JH-FE | 230 | 1150 |
| 100 | El. Dyn. b.b. (2) | 30-S | 230 | 450/1200 |
| 100 | G.E. crane | CO-1831 | 230 | 675 |
| 75/100 | Whse. | SK-191 | 230 | 300/900 |
| 75 | Reliance b.b. | 385T | 230 | 850/1700 |
| 60 | G.E. TEFC b.b. | CD-135 | 230 | 1150 |
| 30/40 | L.A. b.b. (2) | ONW | 230 | 500/1500 |

### MOTOR-GENERATOR SETS

| KW | Mfr. | Input V | Output V |
|---|---|---|---|
| 600 | Allis Ch. | 440 AC | 250 DC |
| 300 | G.E. | 440 AC | 250/350 DC |
| 200 | Allis Ch. (2) | 440 AC | 250 DC |
| 200 | Whse. synch. | 220/440 AC | 55 DC |
| 200 | Gen. Elec.* | 220/440 AC | 125 DC |
| 100 | Delco b.b. | 220/440 AC | 120/240 DC |
| 80 | Star b.b. Synch | 220/440 AC | 250 DC |
| 75 | Allis Ch. b.b. | 220/440 AC | 125 DC |
| 60 | Ideal | 220/440 AC | 125 DC |

**Arthur Wagner Co.**
Certified
MOnroe 6-7409
1435 W. RANDOLPH ST
CHICAGO 7, ILLINOIS

Circle 514 on Reader Service Card

### TRANSFORMERS—60 CYCLE

| QU. | KVA | MAKE | TYPE | PHASE | VOLTAGE |
|---|---|---|---|---|---|
| 2 | 3000 | Moloney | TCR | 3 | 7200-4160/2400 |
| 2 | 3000 | G.E. | OA-T | 3 | 26,400-4160/2400 |
| 1 | 1500 | West. | O.I.S.C. | 3 | 26,400-480 taps-hi |
| 2 | 500 | G.E. | K.S.T.Q. | 1 | 4150-2406 |
| 1 | 300 | Penna. | OA Askarel | 3 | 12,470Y/7200-240 |
| 3 | 200 | Amer. | G.C. | 1 | 4160/7200-240/480 |
| 3 | 200 | G.E. | HS-W2S | 1 | 2400/4160-240/480 |
| 3 | 75 | G.E. | H-form KF | 1 | 2400/4160Y-120/240 |
| 3 | 50 | G.E. | H-form K | 1 | 2400/4160Y-220/440 |
| 3 | 50 | Niagara | Dry-air | 1 | 2400/4160Y-120/240 |
| 3 | 50 | Harrison | Dry-air | 1 | 2400/4160Y-220/440 |

### MOTOR GEN. SETS

| QU. | KW | MAKE | SPEED | D.C. | A.C. |
|---|---|---|---|---|---|
| 1 | 1000 | West. | 720 | 600 | 2300/4160 S.R. |
| 1 | 400 | West. | 900 | 250 | 3 unit 4160 V. syn. |
| 1 | 300 | G.E. | 1200 | 250 | 2300/4160 syn. |
| 1 | 300 | Al. Ch. | 1200 | 125/250 | 3 unit 440 syn. |
| 1 | 175 | West. | 1200 | 125 | 4160 syn. |
| 1 | 100 | West. | 900 | 230 | 4160 syn. |
| 1 | 45 | G.E. | 1170 | 30 | 440V Sq. Cage |
| 2 | 30 | G.E. | 1760 | 230 | 440V Sq. Cage |

### D.C. MOTORS—230 VOLT

| QU. | HP | MAKE | SPEED | TYPE |
|---|---|---|---|---|
| 1 | 350 | G.E. | 1200 | ped. type |
| 1 | 90 | G.E. | 1750 | CDM |
| 1 | 30 | West. | 1750 | SK-113 |
| 1 | 30 | G.E. | 2200 | CD-85 |
| 1 | 15 | Crocker Wh. | 1750 | CCM, TEFC |

### SLIP RING MOTORS

| QU. | HP | MAKE | SPEED | TYPE | VOLTS |
|---|---|---|---|---|---|
| 1 | 500 | G.E. | 450 | MT-422Y | 2200 |
| 1 | 450 | West. | 1800 | CW 4-30-9 | 220 |
| 1 | 350 | West. | 1800 | CW | 2300 |
| 1 | 300 | G.E. | 1170 | 1-15 A | 4150 |
| 1 | 200 | West. | 585 | CW | 440 |
| 3 | 150 | Al. Ch. | 1760 | AY-RW | 2300 |
| 2 | 150 | G.E. | 590 | 1-16 | 4000 |
| 1 | 100 | West. | 1770 | TEFC B.B. | 220/440 |
| 1 | 75 | West. | 1160 | CW 607 | 220/440 |
| 1 | 75 | West. | 600 | CW 774C | 220 |
| 1 | 50 | G.E. | 570 | MT 552 | 220/440 |

### SQUIRREL CAGE MOTORS—3 phase—60 cyc.

| QU. | HP | MAKE | SPEED | TYPE | VOLTS |
|---|---|---|---|---|---|
| 1 | 300 | Al. Ch. | 1200 | TRW | 2200 |
| 1 | 300 | G.E. | 1800 | 6336S B.B. Drip | 4160/2400 |
| 1 | 275 | G.E. | 1180 | KT 559BS | 2200 |
| 2 | 250 | G.E. | 1790 | KTEFC B.B. | 2300 |
| 2 | 150 | G.E. | 1780 | K 6325-S XP B.B. | 440 |
| 2 | 100 | Cont. | 3570 | NP 585-S XP B.B. | 440 |
| 1 | 75 | Cont. | 3565 | NP5058X XP B.B. | 440 |
| 1 | 75 | G.E. | 875 | KT 552Y | 440 |
| 1 | 50 | G.E. | 3530 | KF 405Y Vert. | 220/440 |
| 1 | 50 | Cont. | 3530 | NP 445X XP B.B. | 220/440 |

### MOTORS—SYNCHRONOUS 3 ph, 60 cyc.

| HP | SPEED | MAKE | TYPE | VOLTS |
|---|---|---|---|---|
| 325 | 900 | West. | | 2300 |
| 400 | 450 | West. | HR | 440 |
| 300 | 720 | El. Mh. TEFC | | 2300 |
| 200/100 | 720/360 | West. | | 4150 |
| 150 | 3600 | G.E. | TS 956Y drip | 2300 |
| 150 | 1800 | G.E. | TS | 220/440 |
| 150 | 900 | West. | | 220/440 |
| 125 | 900 | G.E. | TS 7536 | 2200 |
| 125 | 600 | G.E. | TS 7641 | 2200 |
| 75 | 1200 | Cr. Wh. | ALT B.B. | 220/440 |

**FOR POWER J.L. HEMPHILL & CO.**
MG1 34th STREET, NORTH BERGEN, N. J.
PHONE NEW YORK - LONGACRE 5-3227
PHONE NEW JERSEY - UNION 3-2400

Circle 513 on Reader Service Card

# FEATURED ITEMS

### BOILERS

44500 #/hr CE 450 PSI @ 750°F NEW
35000 #/hr CE 285 PSI @ 577°F NEW
18000 #/hr Keeler CP 160 PSI
620 #/hr Cyclotherm 250 PSI

### MOTORS—Class I Group D

350 HP Al. Ch. 3/60/2300/450 RPM
250 HP Cont. 3/60/2300/720 RPM
250 HP Al. Ch. 3/60/2300/3600 RPM
250 HP G.E. 3/60/2300/3600 RPM
200 HP G.E. 3/60/2300/3600 RPM
150 HP Al. Ch. 3/60/2300/3600 RPM

### AIR COMPRESSORS

7500 CFM @ 42.5 PSIG Al. Ch. Cent. 1250 HP
1360 CFM @ 35 PSI Worthington YO 150 HP

### TRANSFORMERS

2000 KVA West. 13200—120 1/60
2000 KVA Al. Ch. 33000—2400 3/60—(2)
500 KVA Al. Ch. 2400—480 3/60
6000 KVA 44000—4160 3/60 Substation

### FURNACE TRANSFORMERS

4450 KVA West. 1/25/1100—80 to 140V (2)
3125 KVA G.E. 1/60/13200—95 to 155V (6)
2500 KVA West. 1/60/1150—95 to 155V (3)
2500 KVA West. 1/25/1000—70 to 140V

### GENERATOR SETS

1250 KVA G.E. 3/60/2300/3600 Cond. 200 PSI
750 KW 3/60/2200/900 RPM 250 V DC MG Set

**HEAT & POWER CO. INC.**
**60 East 42nd St., New York 17, N.Y.**
**310 Thompson Bldg., Tulsa 3, Okla.**

Circle 515 on Reader Service Card

3—Worthington 3500 CFM air compressors, 24x15, #LTC-4, 500 HP gas drive.
1—Chicago-Pneu. 3060 CFM air comp., #19-32-30-18x24, 60 PSI, steam drive.
1—Worthington 150 KW generator, steam drive, 1958.
3—G.E. 1000 KVA transformers, 1Ø, 13800-V.
2—E. Keeler 200 HP water-tube boilers, 160 PSI, stoker-fired.
1—Gardner-Denver air comp., 445 CPM @ 100#, 6 cyl., water-cooled.

**PERRY EQUIP. CORP.**
**1422 N. Sixth St.**
**Philadelphia 22, Pa.**
**POplar 3-3505**

Circle 516 on Reader Service Card

# $10,000,000 Power Plant – Will Divide to suit Customer – Save 50% or More.

**34000 K.V.A.—850 lb., 800°—3 Phase—2400/4160 Volt • New 1954—Used 3½ Yrs.**
**Former American Viscose Corp. Plant, Roanoke, Va.**

**BOILERS:** Three (3) 150,000 lb./hr. Combustion Eng., 850 psi, including
C. E. Spreader Stokers, Fans, Pumps, Control, Coal and Ash Handling Equipment

**TURBO GENERATORS:**

**1—6250 KVA, G.E., 825 lb., 800°F.T.T. Condensing—Automatic Extraction at 265 psig, and 5000 KW, 170,000#/hr with 182,000# Total Flow. 3/60/2400-4160 Volt.**

**1—6250 KVA, G.E., 825 lb., 800°F.T.T. Non Condensing—20 lb. Exhaust—Extraction at 265 psig and 5000 KW. 160,000#/hr with 183,000# Total Flow. 3/60/2400-4160 Volt.**

1—3750 KVA, G.E. Condensing, 250 psi. 3/60/2400-4160 Volt.

1—3750 KVA, G.E., Non-Condensing, 250 psig, 15 lb.; Exhaust. 3/60/2400-4160 Volt.

**1—4600 KVA (4375 KW Max.), G.E., Non-Condensing Turbine #97857, 3600 RPM. New 1955. 250 psig, 575°F.T.T., 20 lb. Exhaust, connected to 3p./120cy./2400-4160v. Generator. Will sell Turbine separately.**

**1—4375 KVA, G.E., Condensing, 825#, 800°F.T.T. Turbine #83590, 3600 RPM. Generator 3p./120cy./2400-4160v. Will sell Turbine separately.**

1—2300/1539 KVA, G.E., Condensing, 3p./120cy./2400-4160v., 250 psig.

1—4608 KVA, G.E., Condensing, 3p./120cy./2400-4160v., 250 psi.

**SUBSTATIONS, 3-PHASE, 60-CYCLE:**

**Non-Inflammable Filled**
**Primary Breakers — 250,000 KVA**
**Interrupting Capacity**

11—1500 KVA, G.E., 4160 to 480/277 V.
1—750 KVA, West., 4160 to 480 V.
2—750 KVA, Wagner 4160 to 480/277 V.
1—500 KVA, G.E., 4160 to 480/277 V.

**TRANSFORMERS: Askerel Filled:**

3—833 KVA, Al. Ch. 1/60/2300-4160 to 480 V.
1—750 KVA, Central, 3/60/4160 to 2300 V.
1—300 KVA, Central, 3/60/4160 to 480/277 V.

**TRANSFORMERS, Dry Type:**

50—9 to 45 KVA, 3 phase, 480 to 120/208 V.

These machines are new listings and definitely will be sold.

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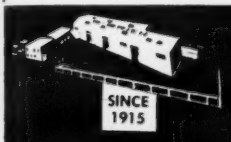


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1937 W. CLEARFIELD ST., PHILADELPHIA 32, PA.

Circle 517 on Reader Service Card

# 4 UNUSED CONDENSING 1250 KW WESTINGHOUSE TURBO GENERATORS

TURBINE: 540 lbs. and 850°T.T. working pressure. 8050 R.P.M.

GENERATOR: 1250 KW 440/3/60—0.80 power factor. 1200 R.P.M. with direct connected exciter. Steam rate about 12 pounds per KW hour.

UNITS SUITABLE TO PRODUCE 1500 KW WITHOUT ALTERATION.

**ALSO AVAILABLE:**

We also have available the following equipment for the above units: 3200 sq. ft. condensers—3200 G.P.M. auxiliary circulating pumps and the condensate pumps.

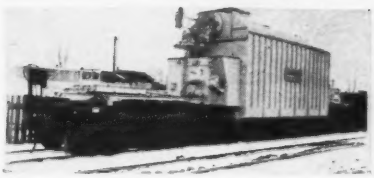
*Send us your inquiries*

**THE BOSTON METALS CO.**
**313 E. Baltimore St., Baltimore 2, Md.**
**ELGIN 5-5050 LEXINGTON 9-1900**

Circle 518 on Reader Service Card

# NEW—UNUSED—ASSEMBLED

**88,000 LBS/HR**
**235 PSI.**



Union Iron Works package type water tube boiler, model MH-T, rated at 88,000 lbs/hr.—235 psig assembled, and delivered new in 1960—never placed in operation—steel encased and capable of being shipped intact aboard RR car without dismantling. IMMEDIATE DELIVERY. Fully equipped.

## OTHER BOILERS IN STOCK

100 hp. Cycloth. pack. 125 psi. oil, automat.
175 hp. Comb. Engr. pack. 375 psi., oil, automat.
250 hp. Cyclth. pack. 150 psi. oil, automat.
300 hp. Leffel sc. mar. 150 psi. oil, automat.
600 hp. B&W, 200 psi., 3 drum, assmd. unused.
45,000 lbs. B&W, 435 psi. pack. oil, assmd. unused.
45,000 lbs. C-Engr. 250 psi. 2 drum, assmd.
60,000 lbs. B&W, 475 psi., oil, pack. assmd. unused.
153,600 lbs. B&W, 635 psi., oil. suprh., econom., etc. unused.

***complete listing catalogue sent upon request***

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**USED—NEW—PURCHASED—SOLD—RENTED**
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Circle 519 on Reader Service Card

## MISS POWER EQUIPMENT SAYS,

*"For BIGGER SAVINGS and BETTER SERVICE, Get Our BARGAIN PRICES on Guaranteed NEW and REBUILT MOTORS"*

**SQUIRREL CAGE MOTORS NEW AND GUARANTEED**

| HP | Make | REBUILT Type | Speed |
|---|---|---|---|
| 500 | G.E. S.B. Open | IK | 1200 |
| 400 | West. B.B. Drip | CSP-631 | 1800 |
| 400 | L.A. B.B. Splash | | 1800 |
| 400 | G.E. S.B. Open | IK | 1200 |
| 400 | West S.B. Open | CS | 900 |
| 300 | L.A.B.B.Splash | FX-148S | 1800 |
| 300 | G.E. S.B. Open | IK | 1800 |
| 300 | Reliance B.B. Drip | AA-6085 | 1200 |
| 300 | G.E. S.B. Open | IK | 900 |
| 300 | Cont. B.B. Splash | N-804 | 900 |
| 300 | G.E. S.B. Open | IK | 720 |
| 300 | G.E. S.B. Open | KT-561 | 720 |
| 300 | G.E. S.B. Open | IK | 600 |
| 250 | G.E. S.B. Open | KT | 1800 |
| 250 | L.A. B.B. Splash | FX-138 | 1800 |
| 250 | West. B.B. Splash | CS-877 | 1200 |
| 250 | L.A.B.B. Splash | FX-137 | 1800 |
| 250 | G.E. S.B. Open | IK | 1200 |
| 250 | G.E. S.B. Open | IK | 900 |
| 200 | G.E. B.B. Open | K-6335 | 900 |
| 250 | G.E. S.B. Open | IK | 720 |
| 200 | L.A. B.B. Drip | 2200 OGX-118 | 1800 |
| 200 | West. S.S.B. Open | CS-855 | 1800 |
| 200 | West. S.B. Open | CS | 1200 |
| 200 | G.E. S.B. Open | IK-15 | 1200 |
| 200 | G.E. S.B. Open | IK-15S | 1200 |
| 200 | G.E. S.B. Open 2200 v. | IK | 1200 |
| 200 | G.E. S.B. Open | IK | 900 |
| 200 | A.C. B.B. Open | AR-826 | 1200 |
| 200 | G.E. TEFCBB | K-565 | 1200 |
| 150 | U.S.B.B. Splash | SC-584 | 1800 |
| 150 | West. TEFCBB | CS-871.5 | 1800 |
| 150 | G.E. S.B. Drip | K-6324 | 1800 |
| 150 | Al. Chal. B.B. Open | AR | 1800 |
| 150 | West. S.B. Open 2200V | CS | 1800 |
| 150 | West. TEFCBB | CS-775 | 1200 |
| 150 | G.E. B.B. Open | KT | 1200 |
| 150 | G.E. B.B. Open | KT-557 | 1200 |
| 150 | Al. Chal. B.B. Open | AR-826 | 900 |
| 150 | Cont. TEFCBB | N-743-X | 900 |
| 150 | Al. Chal. TEFCBB | AZ | 900 |
| 150 | F.M. B.B. Open | H-24A | 900 |
| 150 | G.E. S.B. Open | IK | 900 |
| 150 | G.E. S.B. Open | IK | 720 |
| 125 | G.E. TEFCBB | K | 3600 |
| 125 | Reliance T.E.F.C. B.B. | AA-5084 | 1800 |
| 125 | G.E. S.B. Open | IK | 1800 |
| 125 | G.E. B.B. Splash | K-505 | 1800 |
| 125 | Al. Chal. B.B. Open | AR | 1800 |
| 125 | Reliance B.B. Drip | AA-5084 | 1200 |
| 125 | G.E. S.B. Open | KT-553 | 1200 |
| 125 | G.E. B.B. Open | IK | 1200 |
| 125 | F.M. B.B. Open | H | 900 |
| 125 | G.E. S.B. Open | IK | 720 |
| 125 | G.E. S.B. Open | IK | 600 |
| 100 | West B.B. Open | CS-445 | 3600 |
| 100 | G.E. B.B. Splash | K-445 | 3600 |
| 100 | Al. Chal. T.E.F.C. B.B. | ARZ-823 | 3600 |
| 100 | C.W. B.B. Open 2300 Volt | SC-445 | 3600 |
| 100 | West. B.B. Splash-New | CS-505 | 1800 |
| 100 | Reliance T.E.F.C.B.B. New | AA-445U | 1800 |
| 100 | G.E. S.B. Open | KT-343 | 1800 |
| 100 | G.E. B.B. Open | K-504 | 1800 |
| 100 | Cont. TEFCBB XP | NP-505 | 1800 |
| 100 | Al. Chal. B.B. Drip | ARW-823 | 1800 |
| 100 | G.E. S.B. Open | KT-347 | 1200 |
| 100 | Ideal B.B. Drip New | A-584 | 1200 |
| 100 | West. B.B. Open | CS-607 | 1200 |
| 100 | Al. Chal. T.E.F.C. B.B. XP | 23E8 | 900 |
| 100 | F.M. B.B. Open | H20C | 900 |
| 100 | Al. Chal. B.B. Open | AR-823 | 900 |
| 100 | F.M. B.B. Open | H | 720 |
| 100 | F.M. B.B. Open | H | 600 |
| 75 | West. B.B. Open | CS-445 | 1800 |
| 75 | Reliance TEFCBB | AA-504 | 1800 |
| 75 | G.E. S.B. Open New | K-505 | 1200 |
| 175 | L.A. TEFCBB | JX-505 | 1200 |
| 175 | Al. Chal. T.E.F.C.B.B. | | 900 |

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**POWER EQUIPMENT CO.**
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Circle 520 on Reader Service Card

## ELECTRICAL POWER EQUIPMENT

**SQUIRREL CAGE MOTORS**

3 ph. 60 cy. 220 or 440 volts
(*2200 volts or higher)

| HP | RPM | MAKE | VOLTS | TYPE |
|---|---|---|---|---|
| 1500 | 1800 | Al.-Ch. | 2300 | Ventilated |
| 1250 | 3600 | Al.-Ch. | 4000 | DP/PP |
| 800 | 600 | West. | 2300 | CS-44 |
| 600 | 600 | West. | 2300 | CS-12 |
| 500 | 1800 | G.E. | 2300 | KT-565Y |
| 500 | 1200 | G.E. | 2300 | FT-567 |
| 350 | 3600 | Cr.-Wh. | 440 | SO-68 |
| 350 | 1200 | West. | 440 | CS-22556H |
| 200 | 900 | West. | 440 | CS-8748 |
| 200 | 720 | G.E. | 440 | KF-5648 |

**SLIP RING MOTORS**

3 ph 60 cy 220 or 440 volts

| HP | RPM | MAKE | VOLTS | TYPE |
|---|---|---|---|---|
| 1500 | 514 | Al.-Ch. | 2300 | Mill |
| 1000 | 1200 | Al.-Ch. | 4000 | Any |
| 1000 | 900 | Al.-Ch. | 2300 | Any |
| 600 | 1800 | G.E. | 4160 | M-6345-S |
| 500 | 1200 | G.E. | 440 | M-6345-Z |
| 500 | 900 | G.E. | 440 | IM |
| 350 | 1800 | Al.-Ch. | 2300 | ARY |
| 250 | 720 | G.E. | 4000 | IM |
| 200 | 720 | G.E. | 2300 | MT-566 |

**MOTOR GENERATOR SETS**

| KW | MAKE | MOTOR GENERATOR A.C.V. | D.C.V. |
|---|---|---|---|
| 1750 | G.E. | 4160/2300 | 250/300 |
| 1000 | West. | 4160/2300 | 250 |
| 750 | G.E. | 4160/2300 | 250 |
| 600 | G.E. (3 unit) | 2300/440 | 125/250 |
| 500 | G.E. | 2300 | 250 |
| 400 | Al.-Ch. | 2300/440 | 125/250 |
| 250 | G.E. | 2300 | 250 |

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**From the unfinished Battle Cruiser "Hawaii"**

Material installed completely and never used.

**7 Babcock & Wilcox Watertube Boilers**

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ELGIN 5-5050 — LEXINGTON 9-1900

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**Gas or DIESEL GENERATOR UNITS**
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382 Wayne St. Jersey City, N. J.
Phone: DElaware 2-8300

Circle 523 on Reader Service Card

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**NORTH LITTLE ROCK, ARKANSAS**

(5)—Combustion Eng. Co. 435 HP, 4620 sq. ft. water-tube boilers, 3-drum low-head, 300 PSI, 34,500 lb. Saturated Steam per hour. Gas fired, with oil stand-by system. Built 1943, used very little. *Can be Sold or Leased on Site.*

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Philadelphia 22, Pa.
POplar 3-3505

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2—1250 HP WORTHINGTON NATURAL GAS OR DIESEL ENGINES, 8 CYL. 700 KW GEN. ELEC. 327 RPM, 3/60/2400 V. GENERATORS. WOODWARD GOVERNORS. SWITCHBOARDS, CONTROLS, ACCESSORIES.

1050 HP FAIRBANKS-MORSE DIESEL, MODEL 32, 7 CYL. 257 RPM. 726 KW F-M 3/60/2400 WITH EXCITERS, SWITCHBOARD, ACCESSORIES. CHEAP.

**WHISLER EQUIPMENT CO.**
1908 Railway Exhange Building
St. Louis 1, Mo.

Circle 525 on Reader Service Card

## COMPRESSORS

**No better values at any price**

| | | |
|---|---|---|
| 100 CFM | 150 PSI | 6x7 Ing. ES-1 |
| 138 CFM | 100 PSI | 7x7, Ing. ES, CP & Joy |
| 288 CFM | 100 PSI | 9x9 Ing. Worth. CP |
| 294 CFM | 125 PSI | 9x9 Joy WG-9 |
| 321 CFM | 125 PSI | 10x11 Ing. ES-1 |
| 334 CFM | (actual) 120 PSI | Fuller C70-70H |
| 344 CFM | 1500 PSI | Ingersoll ES-3 |
| 465 CFM | 100 PSI | 12x11-1R-ES-1" Chic. P.T. |
| 502 CFM | 125 PSI | 12x13 Worth HB |
| 593 CFM | 125 PSI | 13½-8½x8 Worth DC2 |
| 640 CFM | 3000 PSI | Worth. DC-4 |
| 686 CFM | 100 PSI | 14x13 Ing. ES |
| 805 CFM | 125 PSI | 17-10x12 CP OCE 150 HP Syn. 3-60-2300 |
| 877 CFM | 125 PSI | 17-10½x14 IR. XRB |
| 2200 CFM | 110 PSI | 26/15x18 Chicago Pneumatic OCE .8PF 350 HP Syn. 3/60/4160 |

**AMERICAN AIR COMPRESSOR CORP.**
48th & P, North Bergen, N.J. UN 5-1397

Circle 526 on Reader Service Card

## FOR SALE

1—2000 KW G.E. Turbine-Generator 400#—750° F Throttle, Automatic 150# and 85# Extraction, 10# Exhaust.

Generator is 2500 KVA, 3-60-480 volt, with exciter and accessories.

## WANTED

2500-5000 KW Turbine-Generators 400-600# Throttle, 700-750° condensing or non-condensing.

**Write to: Joliet Equipment Corporation**
Box 1078, Gross Street, Joliet, Ill.
Or Phone: Joliet SA 7-4738
Chicago BI 2-2458

Circle 527 on Reader Service Card

## MODERN POWER BOILERS

| | | |
|---|---|---|
| 1—Babcock & Wilcox | —122,000#s/hr— | 250 psi |
| 3—Combustion-Engineering | —110,000 | —200 psi |
| 1—Riley | —100,000 | —456 psi |
| 1—Babcock & Wilcox | —100,000 | —450 psi |
| 1—Babcock & Wilcox | — 90,000 | —265 psi |
| 1—Combustion-Engineering | — 75,000 | —250 psi |
| 1—Riley | — 70,000 | —250 psi |
| 2—Babcock & Wilcox | — 70,000 | —450 psi |
| 1—Riley | — 60,000 | —290 psi |
| 2—Combustion-Engineering | — 50,000 | —250 psi |
| 1—Babcock & Wilcox | — 45,000 | —450 psi |
| 1—Combustion-Engineering | — 40,000 | —220 psi |
| 1—Foster-Wheeler | — 40,000 | —200 psi |
| 1—Babcock & Wilcox | — 35,000 | —300 psi |
| 2—Riley | — 35,000 | —250 psi |
| 1—Babcock & Wilcox | — 27,500 | —450 psi |
| 2—Riley | — 19,000 | —200 psi |

**MIDWEST BOILER & TURBINE CO.**
WARNER NEW HAMPSHIRE PHONE 244

Circle 528 on Reader Service Card

## MOTOR GENERATOR SETS

| Q | KW | MAKE | D.C. | A.C. | RPM |
|---|---|---|---|---|---|
| 3 | 750 | West. | 250 | 3/60 | 900 |
| 3 | 750 | G.E. | 250 | 3/60 | 720 |
| 1 | 500 | Elliott | 125 | 3/60 | 720 |
| 2 | 300 | G.E. | 250 | 3/60 | 1200 |
| 1 | 150 | West. | 250 | 3/60 | 1200 |
| 1 | 100 | Star | 250 | 3/60 | 1200 |

## STEAM- TURBO- GENERATORS 3/60

| Q | KW | MAKE | TYPE | I.S.P. | YEAR |
|---|---|---|---|---|---|
| 1 | 10000 | West. | Cond. | 275 | 1932 |
| 1 | 7500 | G.E. | Cond. | 275 | 1948 |
| 2 | 7500 | West. | Cond. | 400 | 1945 |
| 1 | 5000 | West. | Cond. | 400 | 1938 |
| 1 | 3000 | G.E. | Cond. | 400 | 1940 |
| 1 | 1000 | Elliott | N. Cond. | 325 | 1930 |
| 2 | 1000 | Elliott | Cond. | 150 | 1949 |
| 2 | 300 | G.E. | Cond. | 400 | 1945 |
| 1 | 300 | Al. Ch. | N. Cond. | 175 | Late |
| 1 | 200 | Worth. | Extr. Cond. | 250 | 1948 |

## PACKAGE BOILERS

| Q | HP | MAKE | W.P. | FIRING | YEAR |
|---|---|---|---|---|---|
| 6 | 80,000 | B&W | 200 | Pulv. | 1947 |
| 4 | 500 | Cl. Bk. | 200 | Oil | 1942 |
| 1 | 200 | Superior | 125 | #6 | 1957 |
| 1 | 200 | Erie | 160 | #6 | 1951 |
| 1 | 150 | Cyclotherm | 150 | #6 | 1947 |
| 1 | 150 | Cl. Bk | 15 | #6 | 1956 |
| 1 | 70 | Ames | 15 | #2 | 1951 |

## DIESEL GENERATOR SETS

| Q | KW | MAKE | VOLTS | RPM |
|---|---|---|---|---|
| 2 | 2000 | Baldwin | 230V.D.C. | 257 |
| 2 | 1000 | G.M. | 3/60/2400 | 720 |
| 1 | 350 | Worth. | 3/60/480 | 600 |
| 1 | 300 | G.M. | 3/60/220-440 | 1200 |
| 1 | 50 | Superior | 3/60/220 | 1200 |
| 2 | 200 | G.M. | 3/60/220-440 | 1200 |
| 2 | 125 | Worth. | 3/60/480 | 600 |

## AIR COMPRESSORS

| CFM | PSI | MAKE | TYPE | H.P. | VOLTAGE | RPM | YEAR |
|---|---|---|---|---|---|---|---|
| 7550(2) | 24/30 | I.R. | XHE | 600 | 3/60/4160 | 300 | 1948 |
| 6000 | 125 | Sullivan | H | 1250 | 3/60/2300 | 200 | 1943 |
| 1853 | 125 | Worth. | DC-2 | 300 | 3/60/2300 | 277 | 1940 |
| 1700(2) | 125 | C.P. | OCE | 125 | 3/60/480 | 277 | — |
| 1530 | 125 | Worth. | OXP | 250 | Steam | 200 | 1948 |
| 2000(2) | 100 | Fuller | Rot. | 300 | 3/60/2300 | 600 | 1942 |
| 676(2) | 125 | C.P. | OCE | 125 | 3/60/480 | 277 | — |
| 515(4) | 125 | I.R. | 40 | 100 | 3/60/440 | 870 | 1940/50 |
| 404 | 125 | I.R. | XRB | 75 | 3/60 | 277 | — |
| 464 | 100 | I.R. | ES-1 | 75 | 3/60 | 300 | 1950 |
| 368 | 100 | I.R. | ER-1 | 60 | 3/60 | 277 | Late |

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Se Habla Español

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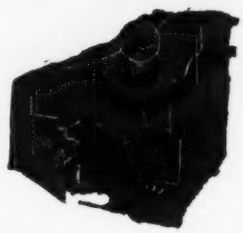
Circle 529 on Reader Service Card

## BOILERS NEW UNASSEMBLED



| # Steam/hr. | Key | PSI | Temp. |
|---|---|---|---|
| 122,500 | DF | 565 | 850 |
| 121,650 | DF | 565 | 850 |
| 60,000 | SF | 435 | 750 |
| 74,000 | H | 280 | 500 |
| 55,000 | A | 240 | — |

DF Double Furnace, SF Single Furnace (illustrated), bent water tube boilers w/economizers and superheaters, B & W's and Foster Wheelers.

H Header type, straight tube, B & W.

A 3 drum, single furnace, Wickes.

**Pelnik-Loconti Industrial Supply, Inc.**

315 Oriskany St., Yorkville, N.Y.

Utica, N. Y. Ph. RE 6-4621, RE 2-4513

Circle 530 on Reader Service Card

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**REWOUND · RE-DESIGNED**

**MANUFACTURED**

*Ask for our Stock List*

**For Sale**

3—2500 KVA G-E 69000—2400/4160Y
3—2500 KVA G-E 69000—7200/12470Y
4—2500 KVA W-H 34500—2400/4800/11000
3—1500 KVA G-E 69000—2400/4160Y
3—1500 KVA G-E 69000—7200/12470Y
3—1000 KVA G-E 34500—7200/12470Y
3— 833 KVA W-H 43800—480

**THE ELECTRIC SERVICE CO., 5322 Hetzel St., Cincinnati 27, Ohio**

*"America's Exclusive Independent Transformer Service Shop"*

Circle 532 on Reader Service Card

## SKINNER VERTICAL UNIFLOW

250 KVA, 480 volt, 3 phase, 60 cycle Skinner, 2 cylinder vertical used universal uniflow generating unit, steam pressure 150 to 175 pounds throttle pressure, 2 to 5 pounds back pressure.

*Available for Immediate Shipment*
*From Original Foundations in Illinois.*

**FRANK M. BEESON ENGINEERING CO.**

1511 W. 27th St., Los Angeles 7, Calif. RE 5-9820

Circle 533 on Reader Service Card

## POWER EQUIPMENT

20000 KW, *NEW*, Gas Turbo-Generator 3/60, 13800 V, 3600 RPM, Immediate shipment

1500 KW, Elliott, Cond. Turbo-Gen. 3/60, 2300 V, 5000/1200 RPM, 250-400 PSIG, 525°-750°TT.

1000 KW, G.E. Non C. Turbo-Gen. 3/60, 2300 V, 3600 RPM, 400 PSIG 600°TT, 90-125 PSIG Exh.

1000 KW, Worthington, Non C. Turbo-Gen 3/60, 240/480V, 4500/1200 RPM, 155 PSIG, 470°TT, 5-10 PSIG Exh.

1000 KW, G.M. 16-278A, Diesel Units (2) 3 Ph. 60 cycle, 2300 V, 720 RPM.

300 KW, G.M. 8-268A, Diesel Units (2) 3 Ph. 60 cycle, 480 V, 1200 RPM.

**BREW, WOLTMAN**
**& COMPANY, INC.**
50 CHURCH ST., N.Y. 7, N.Y.

Circle 531 on Reader Service Card

## DIESEL ENGINE

**1 HEAVY DUTY NORDBERG**

Type T5M—model 32118—1700 HP @ 180 RPM — 21½" x 29". Unit complete with all pumps and coolers. Can be used for generator drive, producing 2400 HP @ 225 RPM. Equal to new. Presently in Maritime Academy.

**THE BOSTON METALS CO.**

313 E. Baltimore St., Baltimore 2, Md.

ELGIN 5-5050 — LEXINGTON 9-1900

Circle 534 on Reader Service Card

*FOR SALE*

## 1050 KVA DIESEL UNIT

1050 KVA Nordberg supercharged diesel engine generator unit, 3 phase, 60 cycle 2400 volts, 327 RPM.

New 1947 — Excellent condition.

*The above unit is still installed and complete with all auxiliaries as in operation. Can be adapted for dual fuel operation.*

**International Power Machinery Co.**
1612 Union Commerce Bldg.—MAin 1-9514
Cleveland 14, Ohio

Circle 535 on Reader Service Card

**New R. R. car mounted. 650 KW, Diesel generator unit.**

480 V., 60 cy., 500 KW Cooper-Bessemer and 150 KW Caterpillar. Complete power plant.

***Most sizes to rent, sell & service. Largest stock in midwest.***

**MIDWEST DIESEL POWER, INC.**
4120 Belmont Ave., Chicago 41, Ill.
AV. 3-3308

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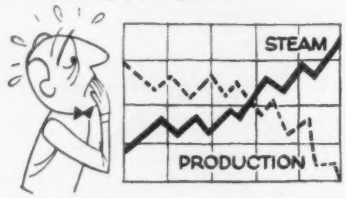
ONE OF A SERIES OF CHATS ABOUT THE CONSERVATION AND CONTROL OF HEAT

# SARCO TOPICS

## STEAM CONSUMPTION WAS ERRATIC AT THE SHERATON-ATLANTIC

This is a documented steam story, and if you have the *least* interest in reduction of steam costs you'll read on. The events took place in the laundry and dry cleaning department of the Sheraton-Atlantic Hotel in New York, which purchases district steam; but they could have happened in *any* steam using establishment — including your plant.




This documentary is concerned with money — (their steam bills for laundry and dry-cleaning were tremendous) and how the Sheraton cut the bill $8500 in one year. That's giving away the climax, but not the plot. To begin with, the Sheraton engineering department kept a daily log which revealed excessive steam costs and startling discrepancies. For example, on one day, 44,000 lbs. of district steam were metered and 20,300 pieces finished. On another day, 38,000 lbs. of steam were metered and 23,300 pieces finished. Clue: This ratio was obviously cockeyed!

To relieve your suspense, we can tell you that the Sheraton removed competitive bucket traps and installed around fifty Sarco Thermo-Dynamic Steam Traps, Type TD-50, on the discharge side of each piece of steam heated equipment, and on drips on supply mains between meters and equipment, as recommended by Sarco. The results were dramatic. (Strong men didn't weep, but they did clap their hands a bit.) In the pre-Sarco December, 868,000 lbs. of steam were purchased for $1725. In the post-Sarco December, only 532,000 lbs. of steam were purchased, for $1025. And the volume of work had increased!

There are no crystal gazers on the Sarco staff; lots of competent engineers, though. These steam detectives find inefficient steam trapping at the bottom of countless high cost mysteries. Sad part of it is, the high cost of steam is only part of the story. Inefficiency in trapping can create other costly problems, too.

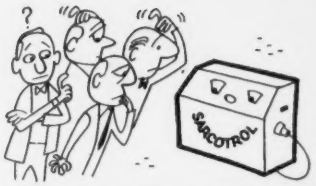
We talk a lot about our Thermo-Dynamic trap, don't we? So do other people. In fact we're quite used to grateful cheers of appreciation. Why don't you get the full story, by asking for it? Phone, telegraph, mail—choose your favorite medium of communication.

## SARCOTROL! OUR WORD FOR SOMETHING SPECIAL IN TEMPERATURE CONTROL

It may be just what you've been looking for. We don't know. It's rather unusual. We know what it can *do*, but we still don't know everyone who needs it, even though we've been selling Sarcotrol successfully for many years to the plastic fabricating industry. New people we never heard of keep popping up saying it's just what they've needed.

When we designed Sarcotrol we planned it for specific use as a heating and cooling unit for injection molds, cylinders, rolls and drums. What surprises us is that so many different kinds of other equipment are evidently now in search of just such a control, from Banbury mixers to electric coffee pot testers.

The Sarcotrol is a portable, automatic temperature control system utilizing closed recirculation of the heat transfer fluid, to insure even temperatures throughout the equipment being heated and/or cooled. Here's the operating principle. Btu's are supplied to or removed from the rapidly moving high-pressure, high temperature fluid; the variations between delivery and return temperatures being held to a very narrow segment of the Sarcotrol's wide temperature adjustment range. A broad range of flow rates is available to handle widely varying heating and cooling loads, while maintaining tight control of temperatures across the equipment. The basic control mechanism is our own electric indicating controller. Four




standard, fully adjustable, working temperature ranges, cover all heating or cooling requirements between 0° and 300°F. (Keep reading . . . you can always go back for details.) On start-up, full heater capacity is available, and when circulating water approaches control point, heat input is automatically reduced for closer control. Temperature control instruments are automatically compensated for ambient temperature variations.

Heard enough? If not, you must feel a responsive chord vibrating, so write for details. There's literature available which contains much more information than we can give you in this chat.

## OUR NEW PUBLICATION IS PRACTICAL—PLUS

SARCOSCOPE is our new house magazine into which we pour what we hope will be a useful mixture of ideas, case histories, tips, facts, news, and sense — both common and uncommon. If you are not receiving

it, we'll be happy to send future issues to you. Just send your name and address. Sarco publishes it as a service to people interested in the conservation and control of heat. We try to keep it down-to-earth, practical and useful.

## SO YOU THINK YOUR PROBLEM'S UNIQUE?

Lots of hot water and steam is being wasted these days, in lots of ways. If your eyes glaze as you watch your steam bills mount or shut down your equipment for maintenance, you probably wonder what you did to deserve such problems. If it's any consolation, it's very unlikely that you are alone in your misery. The chances are excellent we have solved just such a problem already for plants similar to yours. Try us. Describe your problem in a letter. We'll probably be able to send you a set of Sarco Case Histories, describing how other plants were able to conquer problems like yours.

5897

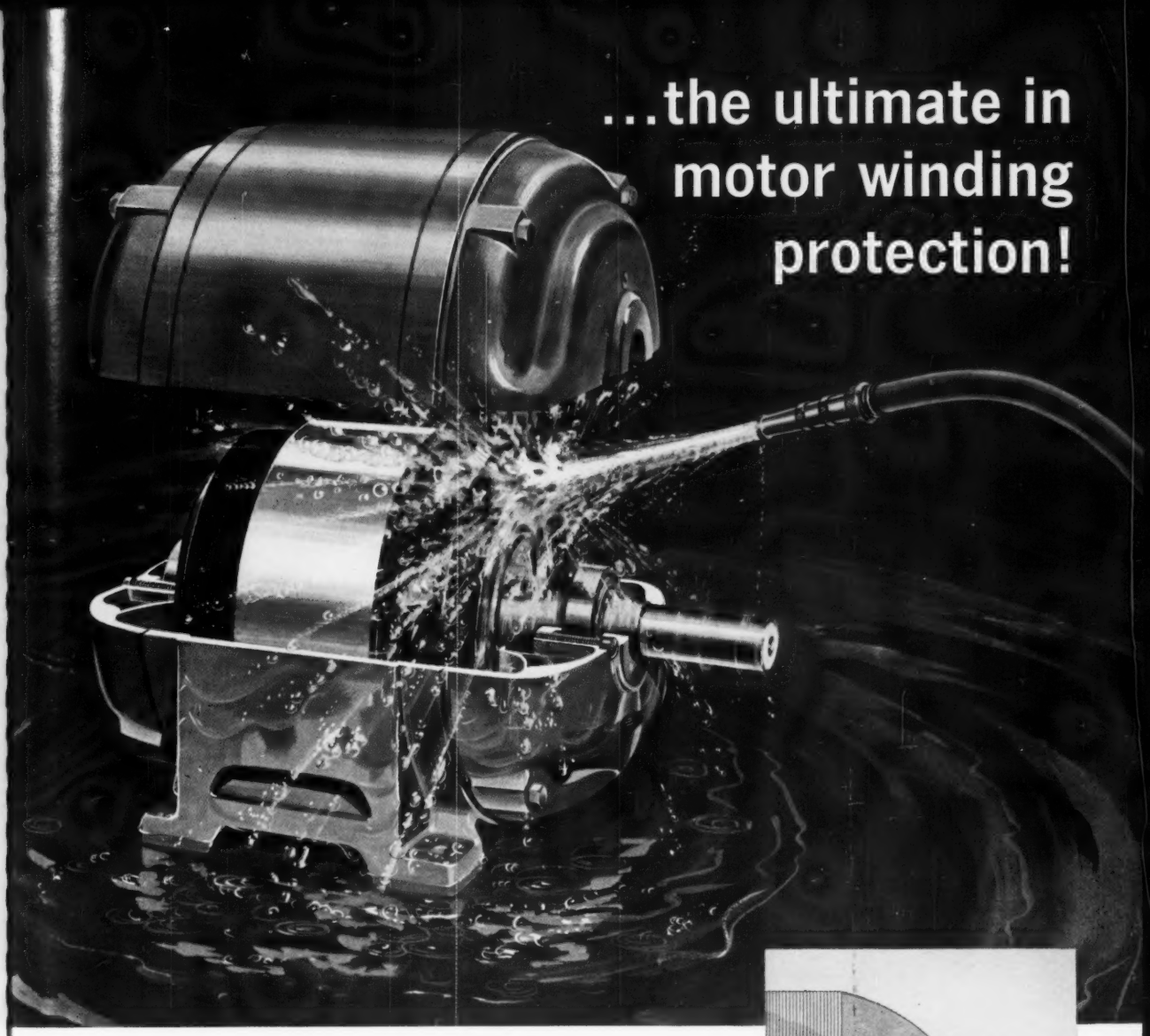
SARCO

SARCO COMPANY, INC.
635 MADISON AVENUE, NEW YORK 22, N. Y.
PLANT: BETHLEHEM, PA.

STEAM TRAPS • TEMPERATURE CONTROLLERS
STRAINERS • HEATING SPECIALTIES



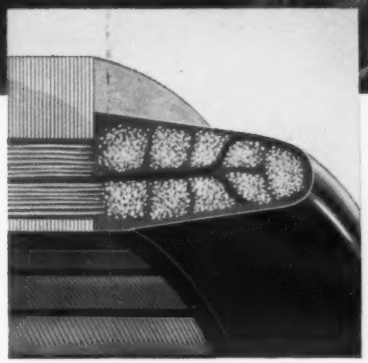
For more facts circle 342 on Reader Service card, p 121




# U.S. EVERSEAL

## *Protects against heat... water... chemicals*

U.S. EVERSEAL resin-encapsulated windings are completely protected against severe environments: Heat, cold, vibration, acids, gases (even in high concentrations), lye, potash, ammonia, caustic soda, salt, abrasives, carbon black, graphic dusts, and many other conditions that formerly meant short motor life. In many applications, EVERSEAL provides the protection of totally-enclosed motors while still maintaining the higher service factor of open motors. U.S. Motors developed a way of molding without excessive thickness. Fully molded U.S. EVERSEAL *complete encapsulation* is available on any U.S. motor, ½ h.p. to 125 h.p. On higher horsepower motors, U.S. offers EVERSEAL silicone rubber insulation. *Request free* EVERSEAL *literature.*



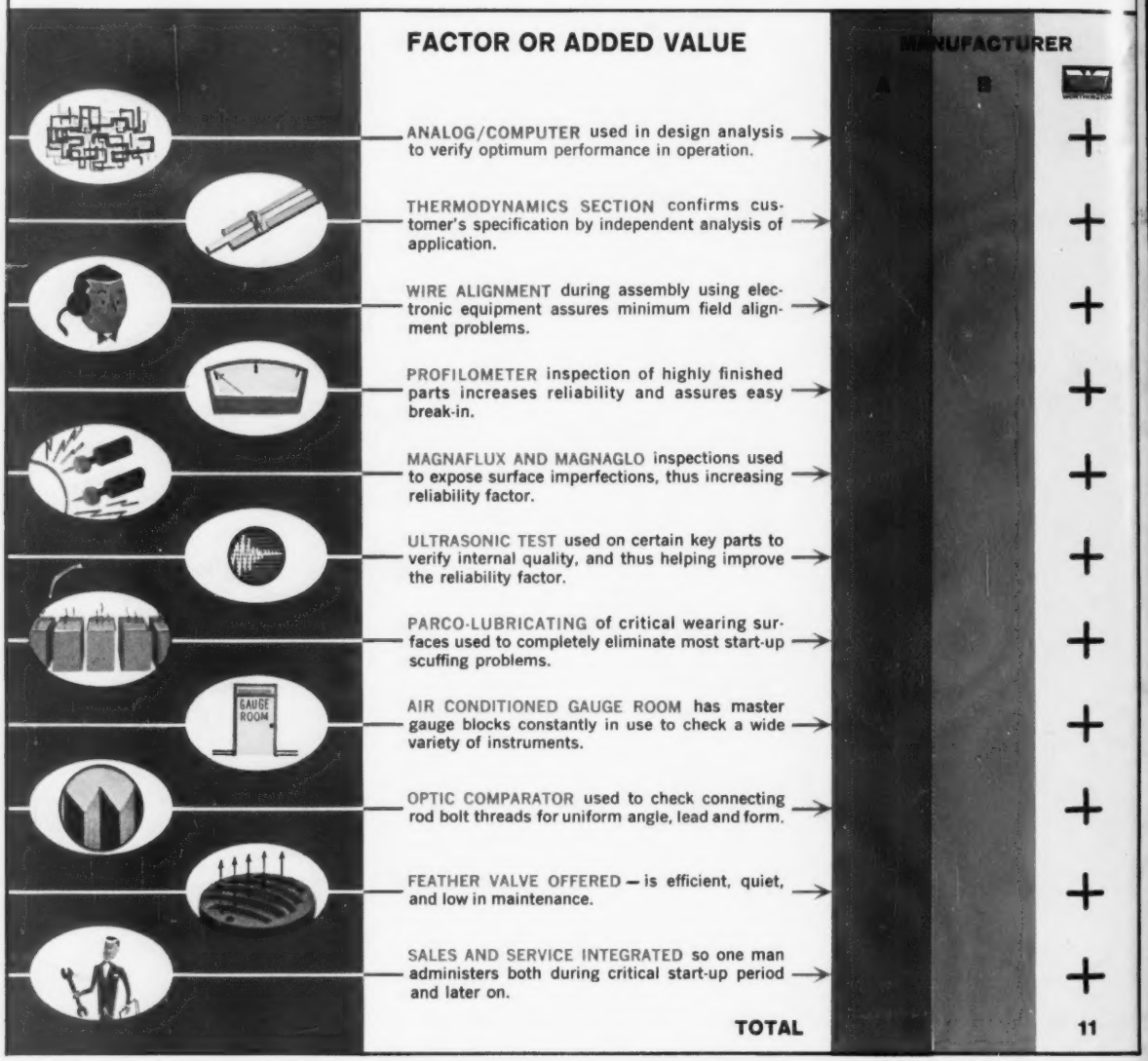
Note complete coverage and protection provided by molded end-turn construction.

**U.S. ELECTRICAL MOTORS INC.**

P. O. Box 2058 • Los Angeles 54, California or Milford, Connecticut

**For more facts c'rcle 202 on Reader Service card, p 121**

## COMPRESSOR QUOTATION EVALUATION


FACTOR OR ADDED VALUE
MANUFACTURER
A
B
ANALOG/COMPUTER used in design analysis to verify optimum performance in operation.
THERMODYNAMICS SECTION confirms customer's specification by independent analysis of application.
WIRE ALIGNMENT during assembly using electronic equipment assures minimum field alignment problems.
PROFILOMETER inspection of highly finished parts increases reliability and assures easy break-in.
MAGNAFLUX AND MAGNAGLO inspections used to expose surface imperfections, thus increasing reliability factor.
ULTRASONIC TEST used on certain key parts to verify internal quality, and thus helping improve the reliability factor.
PARCO-LUBRICATING of critical wearing surfaces used to completely eliminate most start-up scuffing problems.
AIR CONDITIONED GAUGE ROOM has master gauge blocks constantly in use to check a wide variety of instruments.
GAUGE ROOM
OPTIC COMPARATOR used to check connecting rod bolt threads for uniform angle, lead and form.
FEATHER VALVE OFFERED — is efficient, quiet, and low in maintenance.
SALES AND SERVICE INTEGRATED so one man administers both during critical start-up period and later on.
TOTAL
11

# HOW MUCH IS A PRICE?

Above, you see one buyer's check-off of the hidden values buried in a Worthington compressor quotation. It helped indicate the true value of the Worthington offering. But more important than this check-off is the subject involved.

Today's rising costs and minimum profits compel every buyer to scrutinize compressor prices as never before. The problem in determining the true value of an offering is more important and, frequently, more difficult.

What's the answer? For more complete price evaluation, we suggest that you look for the "hidden value" in each manufacturer's offering—in far more detail than above. You can be sure that the true prices will separate very quickly, because "hidden" values vary sharply in the compressor market today.

To help you find, isolate and evaluate compressor offerings, we have prepared an objective "Compressor Evaluation Guide." This booklet points out the six key areas of judgment required for compressor evaluation and details them in full. Ask your Worthington Representative for this booklet or write Worthington Corporation, Dept. 36-17, Clinton Street and Roberts Avenue, Buffalo, N.Y. In Canada, Worthington (Canada) Ltd., Brantford, Ontario.

WORTHINGTON

PRODUCTS THAT WORK FOR YOUR PROFIT

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